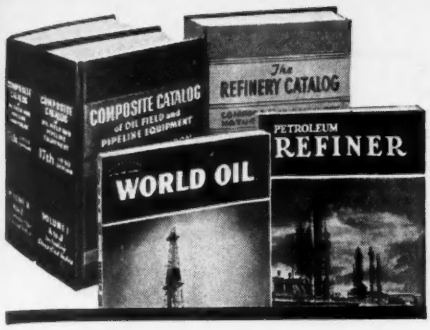

Specialized Oil Publications of
THE GULF PUBLISHING COMPANY
3301 Buffalo Drive, Houston 6, Texas
Box 2608, Houston 1, Texas

WORLD OIL and The COMPOSITE CATALOG
for the drilling-producing-pipe line industry

PETROLEUM REFINER and The REFINERY CATALOG
for the refining-natural gasoline industry

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Single copies 50 cents (except special issues). Subscription price: domestic and foreign, $2 a year; 2 years, $3; 3 years, $4. WORLD OIL, published every month except semi-monthly in February and July. Entered as *The Oil Weekly* as second class mail matter December 23, 1916, at the post office at Houston, Texas, under the act of March 3, 1879. Advertising rates on application. Copyright, 1950, by The Gulf Publishing Company.

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Looking Ahead

IN OBSERVANCE of Oil Progress Week October 15-21, the nation's 2 million men and women of oil will make direct reports to their fellow townsmen on significance of their work and the progress and achievements of their industry.

CRUDE SUPPLY AND DEMAND situation in California is fast returning to normal. Standard Oil Company of California, usual price leader of the region, now is writing one-year contracts with six months' cancellation clause. Last year the company cancelled its one-year contracts, substituted day-to-day contracts, and in some cases reduced takings of heavier crudes that were not in good demand.

ADDITIONAL EXPLORATION and development activity in the Rocky Mountain area will result from enlarged markets that will be provided by a new pipe line to connect the area with the heavy-consuming Midwest.

LOOK FOR additional shipments of German-made oil field tubular goods into the U. S. Such deliveries will be encouraged by the current U. S. shortage and the industry's desire to maintain drilling operations at continued peak rates.

FAILURE OF REFINERS to adopt measures which will provide military needs for 3 million barrels of aviation gasoline between now and end of year could lead to issuance of mandatory government orders under new Defense Production Act.

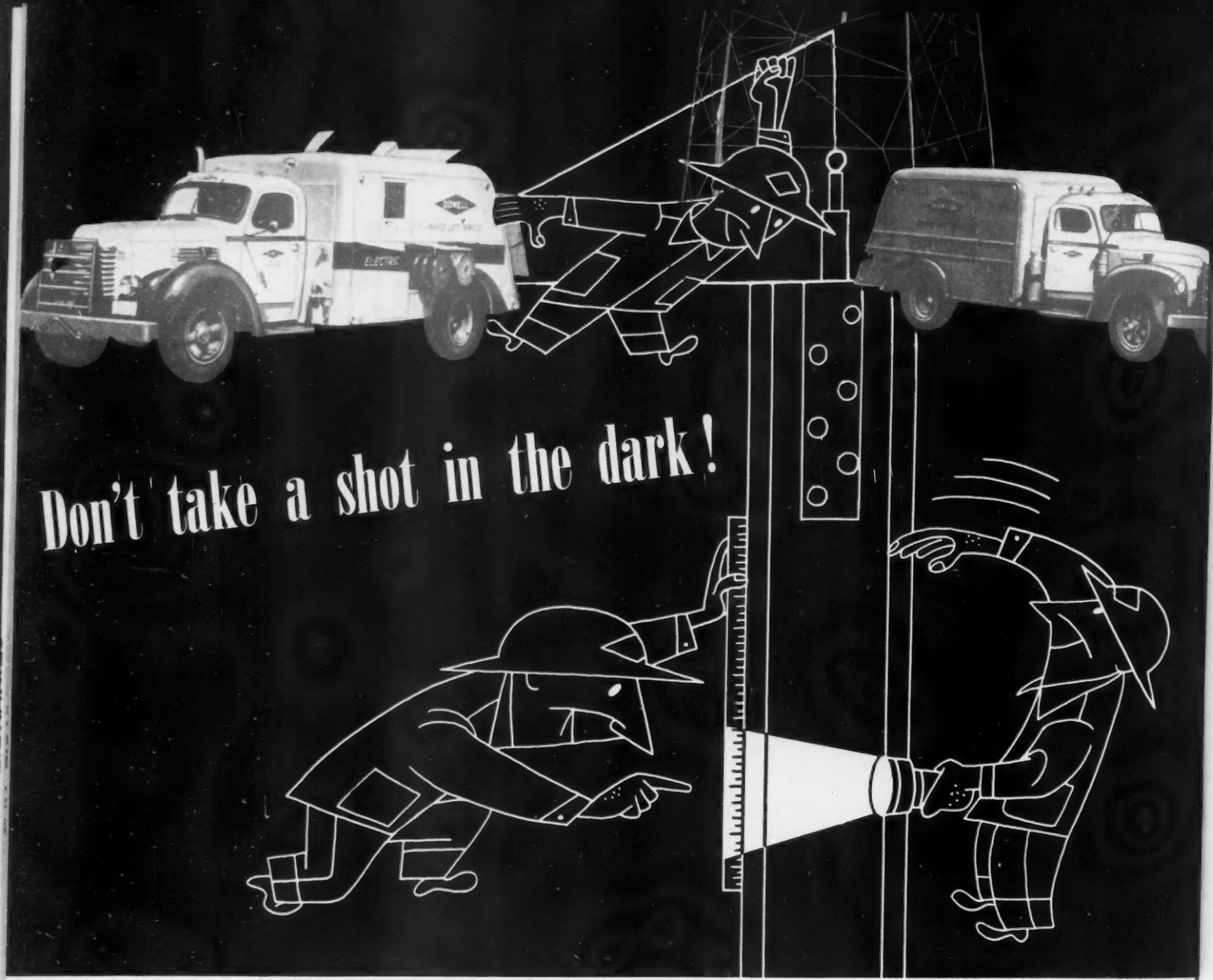
LARGE AMOUNTS of jet fuel that would be needed for all-out war would put kerosine, range oil, and No. 1 distillate fuel oil in critical supply. Diesel-powered city buses would have to be adjusted to use higher end point diesel fuels, and farm tractors fueled by light distillates would have to substitute gasoline.

TO THE 7,217,000 CUSTOMERS that now heat their homes with gas, U. S. gas utilities expect to add 1,150,000 in 1950-51 heating season, 950,000 in 1951-1952, and 900,000 in 1952-1953 season, thereby raising total to 10,217,000. Homes using gas for heating during 1950-1951 season will constitute more than 40 percent of all homes supplied with utility gas service.

ANOTHER ATTACK is likely on oil industry's depletion allowance. Senators Humphrey of Minnesota and Douglas of Illinois, both Democrats, have proposed to wipe out all depletion allowance for oil and gas. They also would write into tax law elimination of provision considering as capital gains rather than ordinary income all amounts realized from sale of a specified number of barrels of oil out of future production.

AN ADVANCED METHOD for producing crude may result in recovery of up to 90 percent of oil in a reservoir. Hydrocarbon gas mixtures are injected into wells at high pressures to achieve this result. This method still is in experimental stage, however, and field tests are to be made later this year.

AMERICAN INDUSTRY in general will have to invest up to $200 billion during next ten years——nearly as much as during past 20 years——if U. S. is to achieve productivity needed to maintain present standard of living. Furthermore, workers will have to increase production by 30 to 35 percent during next ten years.



DOWELL PERFO-JET SERVICE... An improved, more effective method of perforating casing and open hole shooting

Dowell Perfo-Jet Service offers you a bonus beyond a better means of oil well perforating. Dowell Perfo-Jet Service is conducted from Electric Pilot Service trucks, engineered and built by Dowell. This proved equipment incorporates the latest scientific instruments designed to do the job *accurately*, effectively, quickly. Also, the other Pilot Services—Caliper, Water Locating and Permeability Surveys—may be correlated with Perfo-Jet to improve the possibilities of a successful completion.

The high velocity gas jets of Dowell Perfo-Jet Service are used to give deeper, more definite penetration of casing, cement and formation . . . to increase the drainage area of tight wells completed in the open hole . . . and to increase the effectiveness of acid and other well treating chemicals by providing entry channels.

Nearly two decades of experience in oil field service have given Dowell the familiarity with well conditions and problems that is essential to good service. For more effective perforating, call Dowell Perfo-Jet Service.

DOWELL INCORPORATED
TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

DOWELL
PERFO-JET SERVICE

Ask your nearest Dowell station for complete information on these Dowell Services and products: Acidizing Service, Electric Pilot Services, Plastic Service, Chemical Scale Removal Service for heat exchange equipment, Jelflake, Paraffin Solvents, Magnesium Anodes for Corrosion Control and Bulk Inhibited Hydrochloric Acid.

"Petroleum Promotes Progress"

Look to **DOWELL**

FOR OIL INDUSTRY CHEMICAL SERVICE

Editor's Page

MOBILIZE MANAGERIAL SKILL

ECONOMIC AND INDUSTRIAL mobilization on a national scale now is getting under way as the U. S. once again engages in making ready to defend itself with military force. Government contracts for war materials, as yet only a trickle, are to increase greatly in coming months along with the drafting of more men into military service as the defense effort is virtually doubled to 3 million men under arms and to a $30 billion annual defense budget.

As this gigantic and complex mobilization program begins to unfurl it is most disturbing to note indications that valuable past experience is to be ignored and a dangerous experiment tried in the selection of men who will administrate the effort.

Mechanized military armament has changed modern warfare into industrial production contests. Without question the enormous industrial production capacity of the U. S. was the determining factor which enabled this country and its allies to win both World War I and World War II. Now, after five years of sharp postwar expansion, U. S. potential wartime industrial producing capacity is vastly larger than any other on earth by a greater degree than ever before. War equipment in quantities far exceeding volumes manufactured at the peak of World War II can be produced by U. S. industry.

Surely this country has the producing capacity required to again overwhelm its enemies. However, there is more to the problem than having the necessary producing ability. Equally important is the proper administration of government controls which are inevitable in time of war. To a large extent this means the proper utilization of the managerial industrial skill developed so abundantly in this country under a competitive business system which recognizes ability and judgment of individuals.

In all past wars U. S. managerial skill has been mobilized along with production capacity. Industrial leaders were called into government service to direct the mobilization of industrial capacity. Such men as William S. Knudsen, C. E. Wilson, Donald Nelson and many others have served with outstanding distinction.

However, it is becoming apparent that industrial managerial skill is not to be used to the utmost in the present war. Instead it appears that President Truman is going to try to operate with government career men and civil service bureaucrats as directors of mobilization efforts. So far the President, under the Defense Production Act of 1950, has delegated the functions of priorities, allocation of materials and facilities, and the regulation of inventories in this fashion:

Secretary of Interior — Petroleum, gas solid fuels and electric power.

Secretary of Agriculture — Food, distribution of farm equipment and commercial fertilizer.

Interstate Commerce Commission — Domestic transportation and port facilities exclusive of air transport and coastwise, intercoastal and overseas shipping.

Secretary of Commerce — All other materials and facilities.

W. Stuart Symington, chairman of the National Security Resources Board, has been named coordinator of the entire mobilization effort.

Thus it is evident that civil service appointees and government men are to head this nation's current mobilization effort. This is a dangerous experiment which could endanger the U. S. war effort. It ignores the success that industry leaders have achieved in directing similar operations. It substitutes an untried experiment wherein men with the know-how of industry production are to be told what to do by government men who lack the knowledge and ability cultivated by experience in business.

Common sense dictates that experienced industrial managerial skill should be mobilized to administrate the vast and complex national defense industrial operation. Surely men who know how to produce can outproduce those lacking such knowledge.

Warren L. Baker

BAKER CASING SCRAPING WILL SAVE YOU MONEY, AND TIME, AND TROUBLE

There now are two types of Baker Casing Scrapers which safely, efficiently and economically remove bullets, burrs, hardened cement or mud, and even mill scale from the important "working surface"—the inside wall of the casing.

The results are so satisfactory that many operators now consider the use of a Baker Casing Scraper a "must" in well completion, or after every gun-perforating job.

CHOOSE THE TYPE TO EXACTLY MEET YOUR NEEDS

While the rotary rig still is up, and only hardened cement or a limited number of gun-shot burrs are to be removed, the time-tested Baker MODEL "B" Casing Scraper (Product No. 620-B) is recommended. It is usually run just above the bit while drilling out cement, and will completely remove protruding burrs as well as the thin sheath of cement left even after the maximum gauge bit has been used for drilling out.

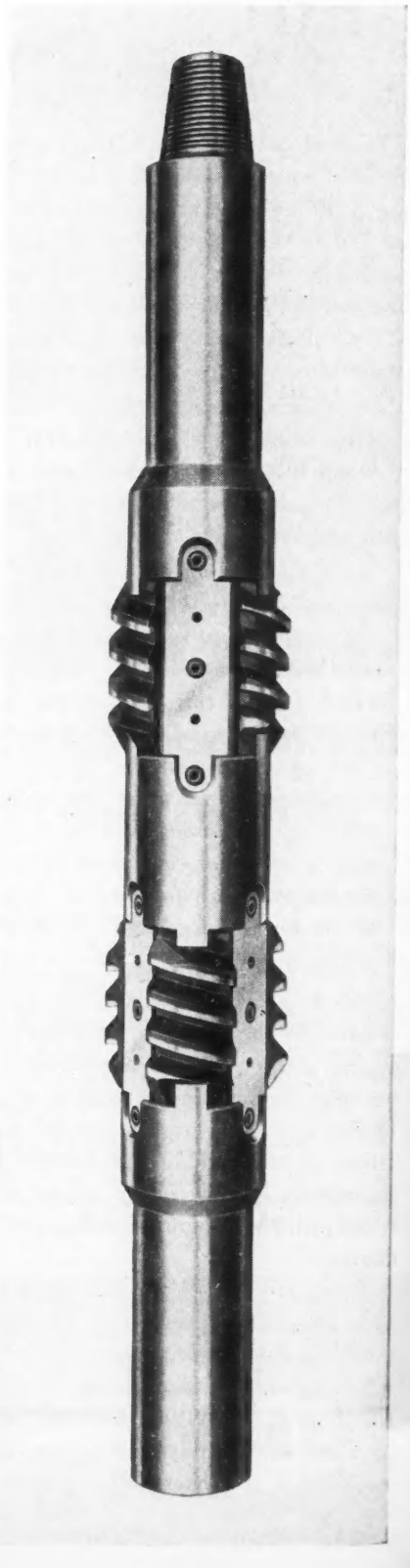
When there are several hundred gun-shot holes (with possible imbedded bullets); or if the hardened mud sheath is to be removed from top to bottom of the well, the new Baker ROTO-VERT Casing Scraper (Product No. 620-C) is recommended. The ROTO-VERT can be run on drill pipe for successful vertical scraping of obstructions as it is being lowered in the hole; followed by rotation if difficult well conditions make rotation necessary or desirable. Or it is run on tubing or a wire line for successful all-vertical scraping.

Either method leaves the inside wall of the casing "clean as a hound's tooth" safe for testing and completion, and ready also for all future down-hole work a year or ten years in the future.

NEW ROTO-VERT IS SAFE AND POSITIVE

The strong, simple construction of this efficient scraper is evident from the illustration which shows the rugged body on which six blade blocks are mounted, and held in position by blade block retainers. The blade blocks are set in two horizontal rows in a staggered position so that the blades overlap and will scrape the full 360° inside wall surface of the casing. The shearing edges are cut on a helix angle and provide a scraping, or shearing, action both while moving down the hole and while rotating. The thrust of each blade block, when rotating, is taken by a driving block which is welded to the body. Springs behind each blade block hold the heavily hard-faced cutting edges against the inner wall of the casing where they exert positive shearing action. ROTO-VERT blades will never screw down past a casing burr because their scraping edges follow the contour of a LEFT-HAND SCREW.

Contact the Baker representative in your area and find out how the reasonable rental is mighty cheap insurance for having *every* well in perfect condition for running tubing or liners, as well as any type of swab, tester, packer or cementing device.



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Casing Scraping
always pays
its way

BAKER OIL TOOLS, INC.
HOUSTON • LOS ANGELES • NEW YORK

The Changing Panorama

Rocky Mountain Line Significant to U.S.

Plans for construction of a large crude oil pipe line from Worland and Casper, Wyo., to Wood River, Ill., are significant to the national economy as well as to the petroleum industry and the Rocky Mountain area.

The new common carrier will go a long way toward overcoming the Rocky Mountain area's major petroleum problem — lack of outlets to heavy consuming regions. Heretofore, the great Rocky Mountain oil belt has had only one intersectional oil transportation system; hence its production necessarily has been largely limited to the small volume consumed locally. Upon completion of the new project in the fall of 1951, crude from this territory will be able to compete on a broad scale with oil produced in Texas, Oklahoma and Kansas for the extensive Midwest refinery markets.

The increase in available markets will act as a great stimulus for oil exploration and development activity in the Rocky Mountains, which is regarded as one of the most favorable prospecting regions in the U. S. Many new fields can be expected from the more extensive exploration that will result. This will have a great influence on the industry and on the economy of the area, and at the same stroke will enlarge the quantity of petroleum available to the American people at a time when more oil appears likely to be needed — sorely needed if extensive warfare develops.

The route of the new system is such that practically all present pipe lines in Wyoming can be connected to it, and at the eastward outlet it will cross and thus can be connected with nearly all major pipe line systems in the Midwest. The line will consist of 140 miles of 16-inch pipe from Worland to Casper, and 938 miles of 20-inch pipe from Casper to Wood River. Due to elevation of the main line station at Casper being about 4700 feet higher than the terminus at Wood River, only two pump stations will provide the line with an original delivery capacity of 70,000 barrels daily. When conditions warrant, the line's capacity can be enlarged to around 150,000 barrels per day by installation of additional stations. The Platte Pipe Line Company which has been organized to build and operate the line, is a partnership of The British-American Oil Company, Ltd., Continental Oil Company, The Ohio Oil Company, The Pure Oil Company, and Sinclair Refining Company.

Coal Spokesman Warns Of Bargaining Pitfalls

Oil companies should avoid industry-wide bargaining at any cost, lest they suffer the same fate as the coal industry.

This warning was given to those attending the annual meeting of the National Petroleum Association at Atlantic City September 14 by Joseph E. Moody, president of the Southern Coal Producers Association.

"Industry-wide bargaining will sooner or later lead down the road to socialism and nationalization," he declared. "The willingness of one company to use expediency in its relationship with its employes and the union can eventually lead it to a place where it can no longer control its destiny in a competitive system."

So far, oil companies have been on guard against and have successfully resisted union efforts toward industry-wide bargaining or even company-wide bargaining involving operations in different parts of the country. On the West Coast there was an industry-wide strike in 1948 which affected both production and refining of virtually all major oil companies and threatened a general shortage of petroleum products. But the companies successfully rejected the demands of the unions and managed to supply customers in the meantime, despite extra costs entailed. In 1950 there were strikes simultaneously at refineries of The Texas Company throughout the country, but the company successfully insisted on handling the strike negotiations at each plant separately and independently.

Oil Industry's Progress Is Agriculture's Gain

The industry's initiative in greatly expanding capacity to produce and refine oil since the end of World War II will have as one of its principal benefits to the nation the assurance of ample oil for large scale power farming. In this way the oil industry will greatly help to solve the problem of providing maximum food supplies with minimum manpower.

This fact was brought out by E. A. Williford, Continental Oil Company, chairman of the Oklahoma Oil Industry Information Committee. He cited a new estimate by API that present horsepower on farms is at a record high of 760 million, 53 percent more than farmers had at the beginning of World War II. This increase does not measure the full extent of gains in power farming, however, as tractors and trucks, the power units most essential to farm operations, have more than doubled since 1941, while automobiles on farms have increased 34 percent.

Another important fact is that the switch from animal to mechanical power in the past 10 years has made 20 million additional acres of land available to grow food for human, instead of animal, consumption. Power units have taken over more than 100 new jobs on farms beyond ordinary field uses. They have brought into significance areas of modern farming stubble mulching, contouring, listing, grassing, and about 50 other soil conservation practices that were too expensive or totally unworkable with animal power. Increasingly, power units are helping more farmers to build up and store reserve productive capacities in the soil.

During World War II, when their ranks were thinned by 5 million men serving in the armed forces and defense industries, farmers used mechanical power to break all production records in feeding this nation and a good part of the rest of the world. Subsequent increases in power units and improvements in their applications strengthen their preparedness today.

Report from the Observatory

Oil's Winter Position Strong

By **RAY L. DUDLEY**, Publisher, and **WARREN L. BAKER**, Editor

THE OIL INDUSTRY approaches the winter consuming season in excellent condition. Producing and refining rates should hold at or near present record levels, as all signs indicate continued strong petroleum demand and stocks of various products are either on the low or conservative side.

The outlook is improved by indications that distillate fuel oil supplies will be more ample than expected previously, and the whole picture also is brightened by the firmness of both crude and refined product prices, the latter being substantially higher than earlier in the year.

• • •

MOST SIGNIFICANT immediate change in prospect is the likelihood that distillate fuel supplies will be larger than previously seemed probable, which will make it easier to satisfy sharp winter gains in demand for this product. It now appears likely that there will be an immediate rapid accumulation of distillate stocks, which will bring them more nearly into line with 1949 levels than seemed likely a short time ago.

This improved outlook is the result of enlarged refinery output of distillate fuels causing greater storage accumulations and indications that sizable additions should continue through October. During the four weeks ended September 16, distillate fuel inventories increased 322,000 barrels daily, twice the 171,000 barrels per day added in the same period of 1949 and also in contrast with a 203,000-barrel per day gain in the preceding four months. Consequently, the 74 million barrels of distillate in storage September 16 was but 6 million barrels less than in 1949 although these stocks had been 10 million barrels under year ago levels of a month before.

• • •

ADDITIONAL GROWTH in the rate of accumulating distillate fuel oil inventories should occur in the interim before the end of October. Further adjustment of refinery yields to increase the output to distillate fuel oil can be expected due to the closeness of the winter consuming season. Moreover, due to reversal of buying trends, demand may temporarily subside slightly from the abnormally high rates which developed after outbreak of the Korean War.

This year both consumers and distributors purchased unseasonably large quantities in July and August as a protection against wartime scarcity and higher prices, whereas in 1949 buying was put off as long as possible in hopes of reduced prices. Consequently, some of the October and November buying of last year took place in July and August this year, and may be reflected in a slight slackening of demand during the next two months. However, when consumers begin replenishing supplies now on hand, demand again should reflect the very sharp growth which has taken place in oil burner installations.

Only a small additional increase in the rate of adding to stocks would boost distillate fuel inventories to the 1949 level of 90 million barrels the end of October. Against an accumulation rate of 322,000 barrels daily during the four weeks ended September 16, the addition of 350,000 barrels per day between September 16 and October 31 would bring stocks to the 1949 volumes.

Of course, early cold weather could upset this outlook, boosting demand to levels which would limit additional distillate stock accumulations to small volumes.

• • •

CRUDE DEMAND should remain strong throughout the entire winter, unless there is a totally unexpected collapse in consumption rates. This seems improbable in view of the number of automobiles, railroad locomotives and oil burners in use, together with the national defense program. The outlook for crude is enhanced by the low level of stocks, which have continued downward despite recent peak producing levels and on September 16 were 23 million barrels less than in 1949.

It seems likely that winter producing rates will remain close to recent all-time record volumes. Although a temporary peak was reached in September due to a reduction in Texas' October allowables, this is not an indication that additional cuts are likely in the future.

• • •

STRONG PRICES also add encouragement to the oil picture, most refined products currently selling at the highest level of the year.

Oklahoma Group 3 82-octane gasoline currently is 10.375 cents per gallon or 1 cent more than in late March and early April. Gulf Cargo 86-octane gasoline now is 11 cents per gallon in contrast with 9.625 cents during the early months of the year. Chicago tank wagon prices for gasoline are 15.5 cents per gallon against 14 cents from March until mid-July.

Heating oil prices also have improved. No. 2 fuel oil in the Oklahoma Group 3 territory is at a peak of 8.125 cents per gallon, although it was bringing only 7 cents early in the year. Gulf Cargo prices for No. 2 fuel is 7.5 cents per gallon compared with 6.375 cents in early March.

Natural gasoline markets have shown much improvement. Group 3 prices advanced in early September to 6.25 cents per gallon in contrast with 4 cents during February, while solvent refined bright stocks had climbed to 31 cents per gallon after selling at 19 cents as recently as May.

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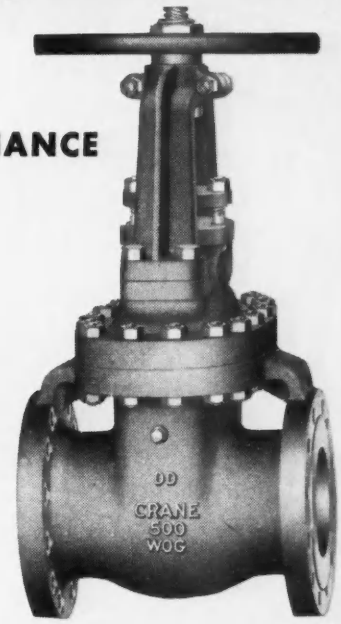

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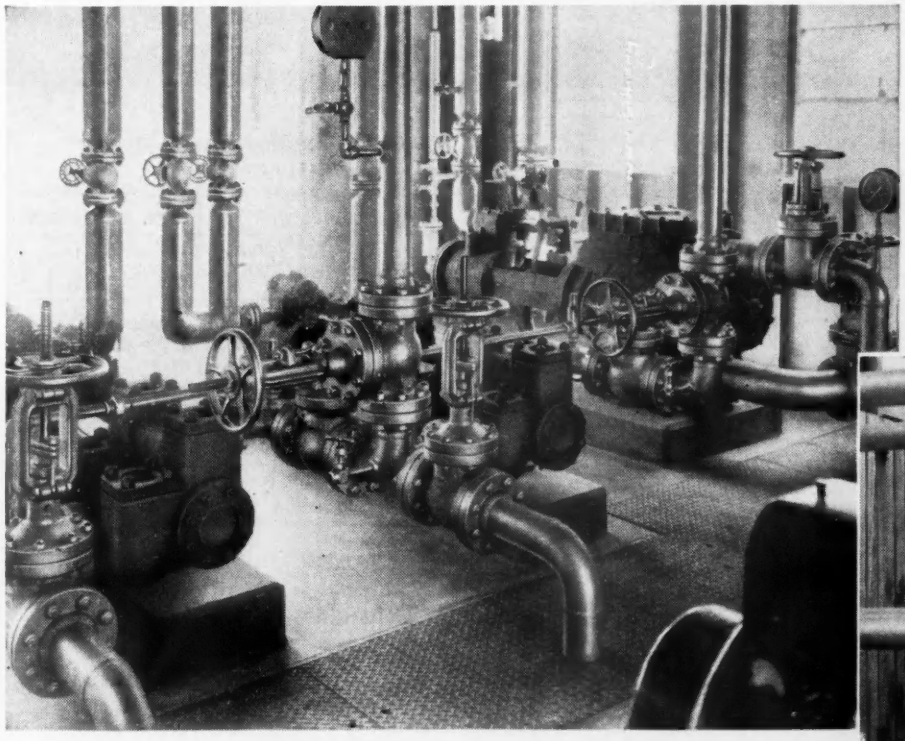

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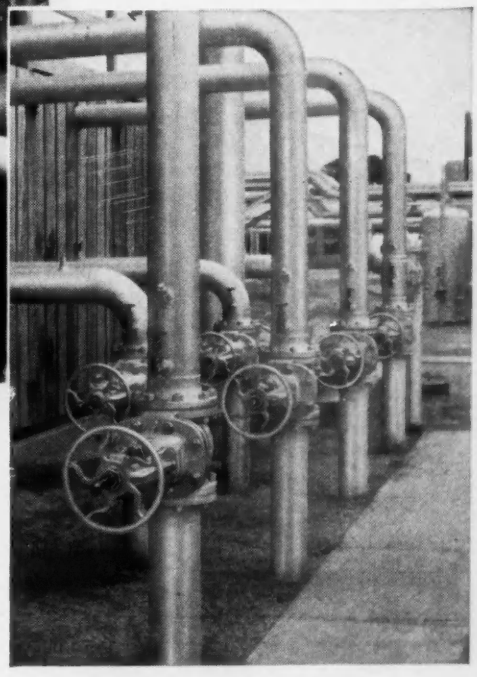

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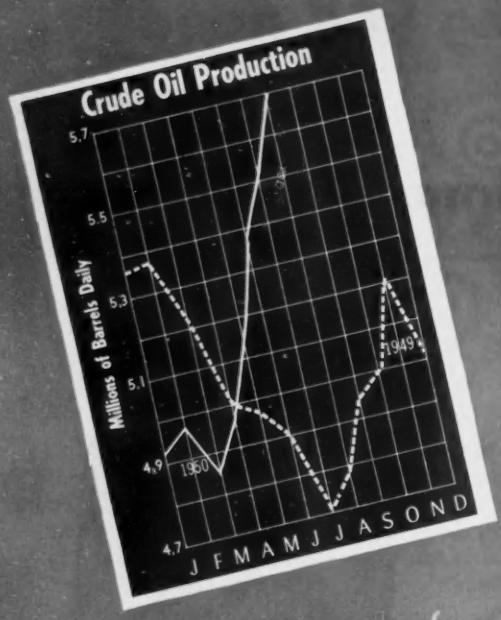
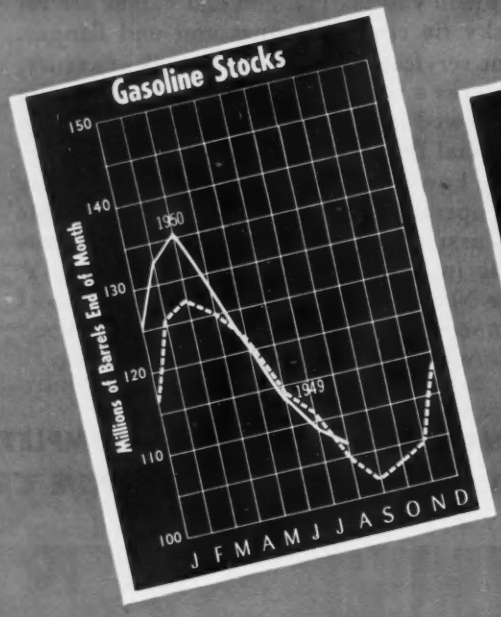
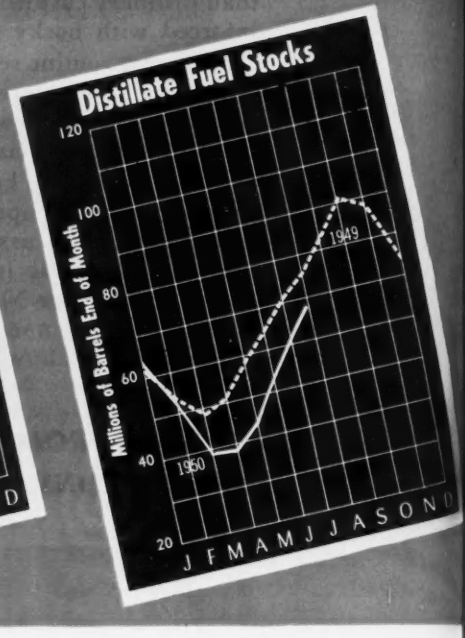
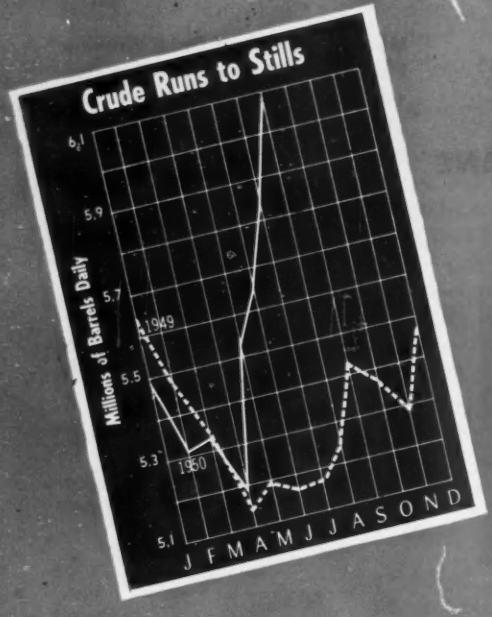
Petroleum

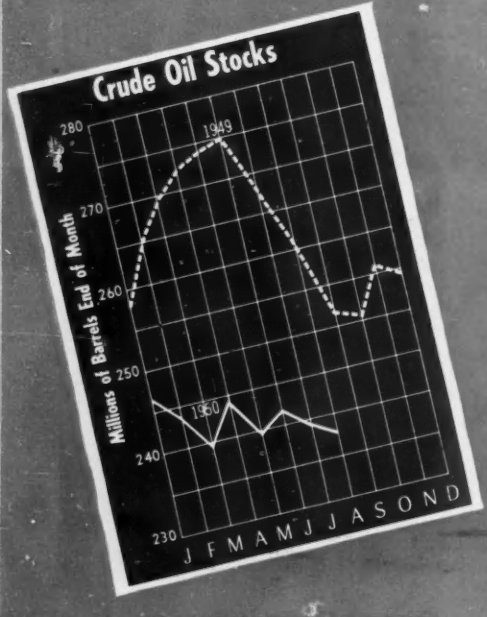
By CECIL W. SMITH
Statistical Editor







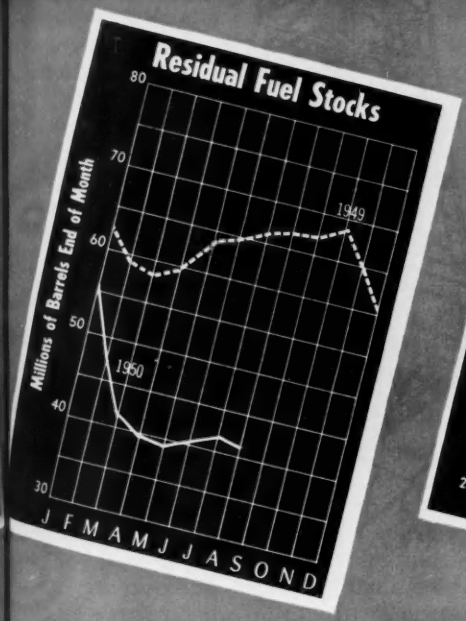


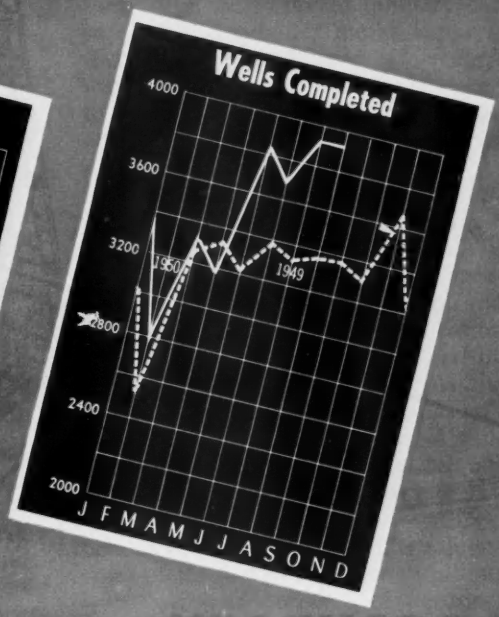


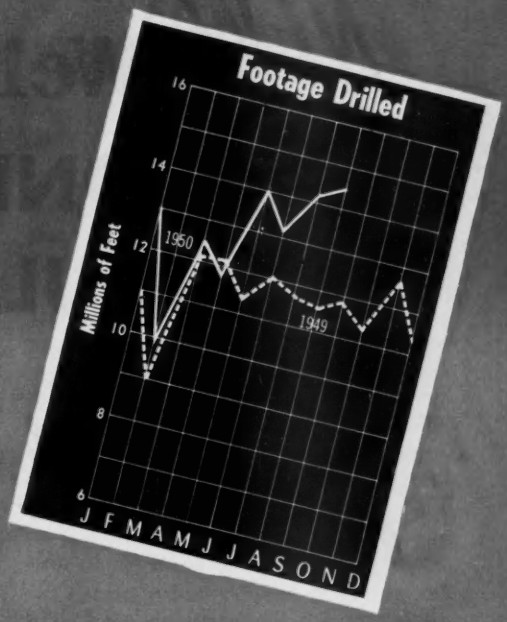
State Crude Oil Production
(THOUSANDS OF BARRELS)

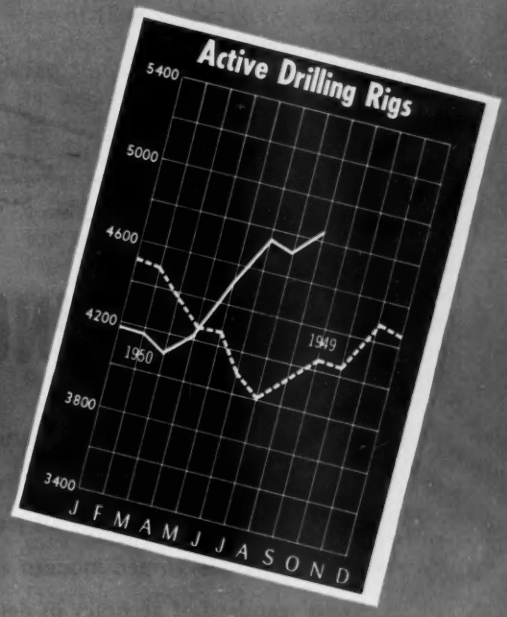
STATE or DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL FIRST 8 MONTHS		
	August, 1950	July, 1950	August, 1949	% Diff. August. '49-'50	1950	1940	% Diff. '49-'50
Alabama	1.9	1.8	1.2	+ 58.3	412	290	+ 42.1
Arkansas	82.1	84.7	77.4	+ 6.1	20,572	19,965	+ 3.0
California	890.0	888.6	896.2	— 0.7	211,918	225,642	— 6.1
Colorado	63.1	59.8	68.5	— 7.9	14,734	16,098	— 8.5
Florida	1.6	1.5	1.5	+ 6.7	294	321	— 8.4
Illinois	177.0	176.5	182.3	— 2.9	41,814	42,672	— 2.0
Indiana	31.4	30.9	27.0	+ 16.3	6,672	6,046	+ 11.8
Kansas	301.4	298.2	257.1	+ 17.2	70,370	67,865	+ 3.7
Kentucky	27.9	28.6	23.0	+ 21.3	6,499	5,538	+ 17.4
Louisiana	574.5	588.5	498.6	+ 15.2	134,374	125,165	+ 7.4
North Louisiana	116.4	128.6	120.5	— 3.4	29,430	29,573	— 0.5
South Louisiana	458.1	459.9	378.1	+ 21.2	104,944	95,592	+ 9.8
Michigan	44.9	45.1	45.6	— 1.5	10,876	10,831	+ 0.4
Mississippi	108.1	113.1	100.8	+ 7.2	25,095	25,840	— 2.9
Missouri	0.1	0.1	0.2	— 50.0	19	32	— 40.6
Montana	23 9	23.4	24.5	— 2.4	5,414	6,238	— 13.2
Nebraska	2.6	2.4	0.7	+271.4	581	165	+252.1
New Mexico	134.0	131.0	127.8	+ 4.9	31,496	32,044	— 1.7
New York	14.0	13.8	12.0	+ 16.7	2,935	2,873	+ 2.2
Ohio	9 8	9.4	10.0	— 2.0	2,279	2,296	— 0.7
Oklahoma	465.2	441.7	399.6	+ 16.4	103,723	100,584	+ 3.1
Pennsylvania	31.1	30.9	31.6	— 1.6	7,663	7,712	— 0.6
Tennessee	0.1	0.1	0.1	.....	14	8	+ 75.0
Texas	2,467.0	2,374.4	1,850.5	+ 33.3	516,802	493,963	+ 4.6
Dist. 1—South Central	29.5	29.5	25.9	+ 13.9	6,657	6,398	+ 4.0
Dist. 2—Middle Gulf	140.8	141.4	115.0	+ 22.4	30,138	32,131	— 6.2
Dist. 3—Upper Gulf	431.5	412.5	355.1	+ 21.5	90,617	96,561	— 6.2
Dist. 4—L. Gulf-S.W.	222.8	221.1	181.1	+ 23.0	47,830	48,054	— 0.5
Dist. 5—East Central	41.0	36.7	32.5	+ 26.2	7,934	9,227	— 14.0
Dist. 6—Northeast	374.0	373.4	307.3	+ 21.7	82,766	85,980	— 3.7
Dist. 7-B—North Central	72.5	72.2	57.8	+ 25.4	16,144	14,560	+ 10.9
Dist. 7-C—West Central	61.4	65.8	42.8	+ 43.5	12,485	10,832	+ 15.3
Disy. 8—West	847.5	776.1	521.4	+ 62.5	100,372	138,364	+ 15.9
Dist. 9—North	154.0	153.2	137.5	+ 12.0	34,148	32,195	+ 6.1
Dist. 10—Panhandle	92.0	92.5	94.1	— 2.2	22,131	21,988	+ 0.7
Utah	3.3	3.2	1.8	+ 83.3	773	157	+392.4
Virginia	0.1	0.1	0.1	.....	17	28	— 39.3
West Virginia	7.7	7.7	8.2	— 6.1	1,901	1,843	+ 3.1
Wyoming	162.4	158.2	134.1	+ 21.1	38,359	30,938	+ 24.0
Total United States	5,625.0	5,513.7	4,780.4	+ 17.7	1,255,696	1,225,154	+ 2.5

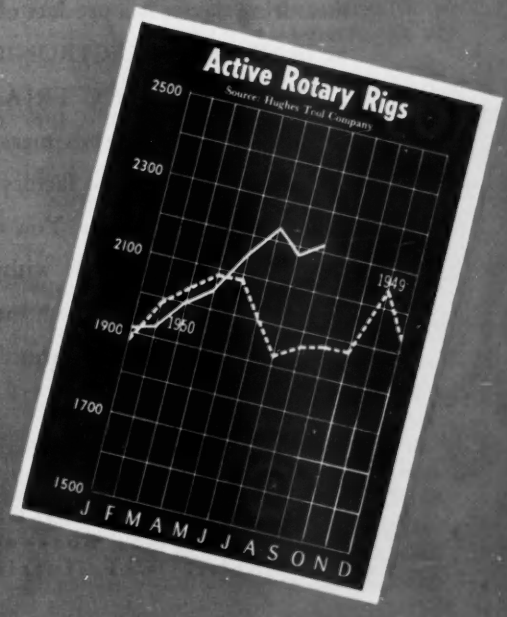
nTrends in the U.S.











Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month
1948:									
June	5,544	5,632	231,412	2,529	104,518	998	45,835	1,280	44,213
July	5,522	5,631	230,955	2,494	98,839	994	56,045	1,264	49,448
August	5,577	5,621	231,954	2,532	95,445	1,038	65,887	1,248	55,009
September	5,435	5,376	237,302	2,416	90,518	961	73,854	1,154	58,682
October	5,632	5,594	243,972	2,490	92,426	1,069	79,992	1,268	61,456
November	5,675	5,672	250,066	2,551	95,589	1,081	80,658	1,277	64,865
December	5,688	5,720	256,254	2,626	103,697	1,106	71,475	1,299	64,021
1949:									
January	5,365	5,641	258,648	2,538	116,621	1,063	61,584	1,348	62,508
February	5,376	5,480	265,216	2,484	126,054	1,004	53,937	1,282	59,398
March	5,224	5,352	269,341	2,470	127,443	993	48,923	1,258	58,190
April	5,012	5,141	272,520	2,494	125,351	846	51,231	1,147	59,668
May	4,972	5,195	273,912	2,585	121,602	813	57,442	1,138	63,576
June	4,903	5,162	274,691	2,597	114,041	771	64,730	1,041	64,628
July	4,704	5,173	267,586	2,613	111,217	835	71,553	1,040	66,084
August	4,780	5,241	260,585	2,593	104,879	902	76,037	1,078	66,843
September	4,940	5,427	251,689	2,617	101,799	1,002	83,213	1,110	67,117
October	5,997	5,373	250,932	2,643	103,287	1,001	90,643	1,141	68,673
November	5,210	5,293	256,010	2,594	104,707	962	88,212	1,180	65,112
December	5,024	5,475	253,356	2,633	111,521	1,032	75,207	1,203	60,193
1950:									
January	4,922	5,483	246,610	2,575	125,298	1,048	63,932	1,209	55,808
February	4,967	5,316	243,750	2,552	132,796	1,026	52,206	1,172	47,828
March	4,878	5,336	241,098	2,539	133,766	938	37,777	1,154	41,860
April	4,968	5,193	244,605	2,508	128,057	977	37,530	1,048	39,979
May	5,143	5,535	239,877	2,647	121,035	997	42,739	1,063	39,482
June	5,378	5,655	242,287	2,748	114,074	1,037	53,679	1,069	40,124
July	5,514	5,844	239,829	2,824	109,117	1,038	61,665	1,139	42,121
August	5,696	6,085	237,771	2,917	105,629	1,081	68,225	1,170	41,511
Aug., 1950 Change:									
In Month	+182	+241	−2,058	+93	−3,488	+43	+6,560	+31	−610
In Year	+916	+844	−22,814	+324	+750	+179	−7,812	+92	−25,332
Week Ended:									
Sept. 16, 1950	5,938	5,983	237,000	2,804	104,305	1,188	74,136	1,166	42,208
Sept. 17, 1949	4,901	5,306	260,409	2,549	103,331	952	80,114	1,069	68,527

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Monthly News Analysis

Industry Able to Meet Needs in Major Conflict

The petroleum industry will be able to meet any possible military needs and also supply essential civilian requirements, and can supply civilians simultaneously with higher quality gasoline than was available during World War II. This was the consensus of a panel of experts September 14 at the annual meeting of the National Petroleum Association at Atlantic City. They emphasized, however, that the military must give sufficient notice of requirements, so that the various endeavors necessary to meet a national emergency can be properly planned and coordinated.

The oil men also stated that military and government agencies must see to it that necessary amounts of steel, lead, chemicals, and other materials are allocated in sufficient quantities for drilling, production, refining, and transportation operations. This was emphasized because shortage of essential materials hampered and restricted the oil industry's operations in World War II.

Tetraethyl lead, anti-knock agent in gasoline, will be in adequate supply to meet any possible military use and also probably for civilian automobiles, and the gasoline to be available will be very much better than that in World War II, according to Dr. Graham Edgar, vice president of Ethyl Corporation.

This opinion takes into account that capacity for producing tetraethyl lead has increased steadily since the end of World War II, and should be 50 percent greater by 1952 than in 1945. While military needs should be easily met, the capacity available for use in civilian gasoline will be several times what was available during World War II. Total war probably would not cause a serious shortage of raw materials except possibly pig lead, and that is in relatively good supply due to government stockpiling and availability in U. S., Canada, Mexico and Australia. Lead supplies did not fail in World War II and should henceforth be adequate.

Dr. Gustav Egloff, research director of Universal Products Company, Chicago, noted that the oil industry currently is producing 3 million barrels of motor fuels a day and can produce another ½ million from crude now shut in. "In an emergency," he said, "the gasoline demands for military, industrial and necessary civilian use will be far higher than normal. The oil industry can supply any demand made by the Armed Forces for motor fuels, and the chemical industry can supply antioxidants, metal suppressors, and tetraethyl lead. However," warned Egloff, "these industries need to know a sufficient time in advance what volume of motor fuels will be required for military and civilian purposes, so that necessary facilities may be provided. If fuel demands increase markedly, allocation of steel will be necessary for increasing crude production, transportation, refining, and distribution of products." Repeating that the industry must be advised by the military as to requirements, he pointed out that "The military can't push a few buttons and expect millions of barrels of products to be rolling to distant points in a few days."

C. M. Larson, Sinclair Refining Company, stated that the large quantities of jet fuel needed for an all-out war "will cut deeply into kerosine, range oil, and No. 1 fuel oil production." Higher end point diesel fuels and gasoline will have to take the place of diesel fuels and light distillate type farm tractor fuel, he said.

Interior Receives Broad Powers Under New Act

Department of the Interior, headed by Secretary Oscar Chapman, is top government authority on oil and gas matters under the executive order through which President Truman delegated to various government agencies his Defense Production Act powers. To carry out his responsibilities, Chapman at mid-September was expected to set up a "Petroleum and Gas Administration," patterned after World War II's Petroleum Administration for War, and to establish separate agencies to handle electric power, solid fuels, and general minerals responsibilities.

When and if necessary, the Interior Department may: (1) control distribution of crude and products through use of priorities and allocations powers, though not ration at consumer level; (2) act as claimant before the National Production Authority in the Commerce Department for oil industry requirements of essential materials such as steel, and if conditions require and NPA consents, may regulate use of those materials by the industry; (3) negotiate voluntary agreements within the industry for achieving objectives of the act, with participants exempt from antitrust laws, subject to approval of the Attorney General and after consulting with chairman of Federal Trade Commission; (4) serve as guaranteeing agency on whose authority Reconstruction Finance Corporation would be required to make loans for expansion of oil refining or other facilities.

Certain other powers affecting oil have been delegated by the President to other agencies. To the Administrator of General Services goes authority to purchase "raw materials, including liquid fuels, for government use or resale." Interior and Defense departments would have to deal with oil industry for aviation gasoline needs, etc. through this agency.

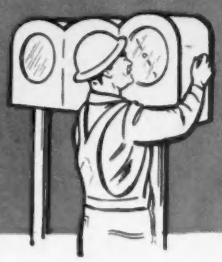
The Secretary of Labor is made top authority on "labor needs of defense industry and essential civilian employment," with power to determine what are critical occupations and with Secretary of Defense and director of selective service to develop deferment policies respecting all but civilian personnel in the reserves.

National Production Authority, new agency for administering allocations and priorities of materials necessary to defense and essential industries, headed by William Henry Harrison, president of International Telephone & Telegraph Company, will be directly under control of Secretary Sawyer of the Department of Commerce.

Jurisdiction over barges, tank cars, and tank trucks goes to the Interstate Commerce Commission, while tankers are under the Department of Commerce.

In late September, J. R. Parten, Houston, president of Woodley Petroleum Company, was being sought as head of Interior's proposed new petroleum industry agency, which was expected to revolve around the existing Oil & Gas Division of the Interior Department, headed by Hugh A. Stewart. It was believed the new agency would be built into a staff totaling 150 to 200 experts. Parten was PAW Transportation Director during World War II. It was said President Truman asked him to head

GROVE REMOTE CONTROL



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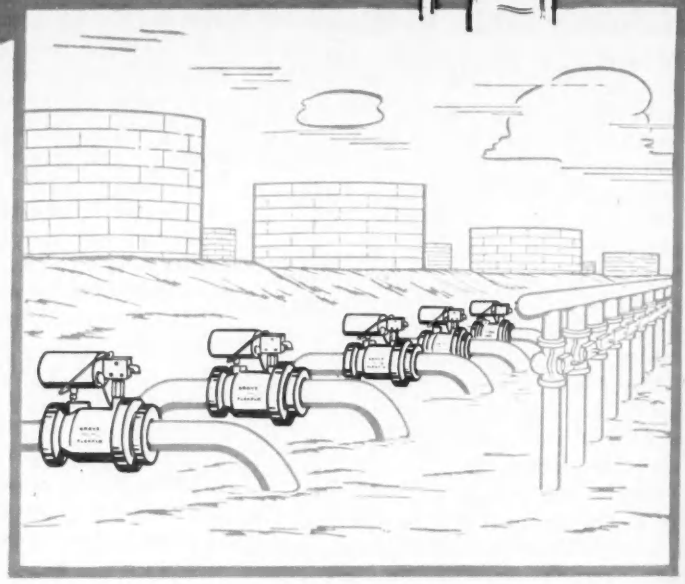
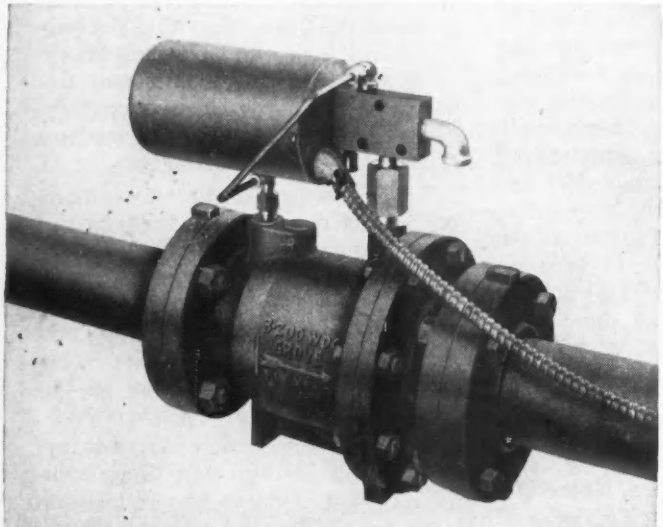
Electrical operation of the Grove FlexFlo is the practical, dependable solution to your remote control requirements. No motors or complicated wiring are necessary. The pressure in the line does the work, opening the FlexFlo with a smooth, rolling action, or closing it with a bubble-tight seal.

The Solenoid Pilot, mounted on the valve, is controlled from a remote panel. This Pilot uses the actual line pressure to open or close the FlexFlo. In this way the Grove FlexFlo Remote Control Valve can be operated as surely and easily as if the operator were at the valve.

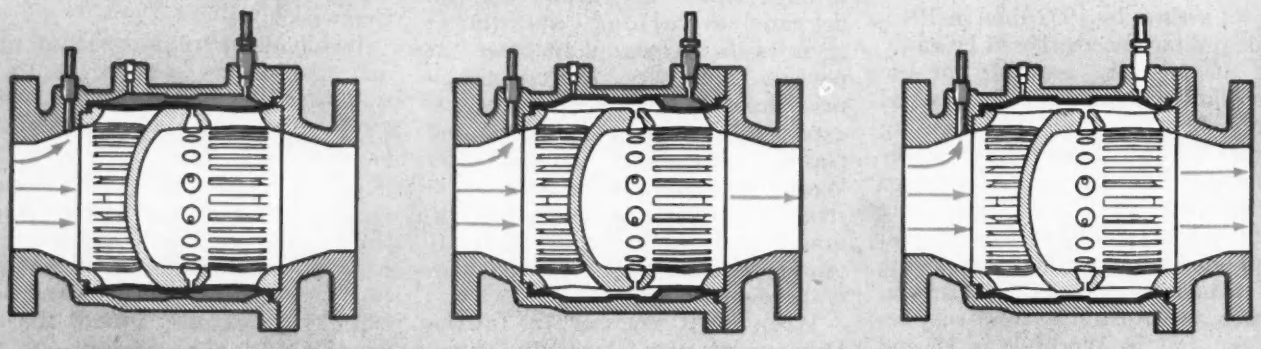




The simple FlexFlo design has been proved in more than ten years of hard service to be unequalled for dependability and long, trouble-free life in the control of air, gas, oil, water, and salt water at temperatures to 150° F. and at pressures to 1500 p.s.i.

Let the Grove FlexFlo engineer show how this dependable remote control valve will increase the efficiency of your plant's operations. Write for full information.

flexflo LETS PRESSURE DO THE WORK



The only moving part in the Grove FlexFlo is a tough Buna N tube, which fits closely around a slotted metal core. When closed, line pressure from within, tending to force the tube off the core, is opposed by equal line pressure on the outside of the tube. Equalizing the inner and outer pressure allows the elasticity of the tube to grip tightly around the core with a positive, sealing action.

As the control pilot closes off line pressure acting on the outside of the tube, inner line pressure, being greater than the outer, begins to roll the tube off the core, opening the FlexFlo.

When pressure on the outer side of the tube is entirely removed, the inner pressure forces the tube completely off the slotted core, opening the valve wide and permitting free flow.

GROVE REGULATOR COMPANY

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the new agency after the job was declined by Ralph K. Davies and Bruce K. Brown, key officials of PAW.

Pending completion of the petroleum setup, Chapman has appointed Albert Wolf to head a minerals and energy unit that will deal with oil as well as other matters until the final organization is under way.

The immediate program will be based on voluntary agreements, which have been made exempt from anti-trust laws wherever such joint action is demanded by the Secretary of the Interior, provided he has consulted with the chairman of the Federal Trade Commission and secured approval of the Attorney General.

Distillate Fuel Oil Supply Enough for Winter Ahead

Unless military requirements exceed present indications, supply of distillate fuel oil for the 1950-1951 heating season will be adequate, it is indicated by an analysis of the current trend of distillate production at East Coast and Gulf Coast Refineries. Such an analysis was offered in *The Digest*, bulletin of the Independent Oil Men's Association of New England.

In a survey of distillate stocks as of August 12, the association found that stocks of No. 2 fuel at refineries and in bulk terminals on East Coast and Gulf Coast were 23 percent below 1949 but that total stocks, including secondary and consumer storage, were only 2 percent under last year.

With stocks no greater than last year and a sharp increase in demand in prospect, scarcity can be avoided only by increased production in proportion to the gain in demand. But fortunately, according to the survey, production so far has been in line with the greater requirements. The rate of distillate production since June increased more than 20 percent compared with the same period last year, the study showed. It is estimated that there will be 400,000 new oil burners in service during the coming heating season. But "even a severe winter added to increased demand from the new oil burners would not appear to develop an increase in total heating demand much greater than 20 percent."

According to the survey, "400,000 new burners would require about 16 million barrels, and a winter 10 percent colder than in 1949 would require about 15 million barrels additional. This combined additional requirement of about 31 million barrels would represent about a 20 percent increase in demand over an estimated 150 million barrels consumed in Districts 1 and 3 in 1949 for heating purposes. This potential increase in demand is, at least for now, being matched by the increased rate of production since June," the analysis concluded.

Heavy Producing Wells In California Re-opened

Reflecting the tighter supply of heavy crude oil, California operators currently are re-opening hundreds of heavy oil producing wells. This action is being taken principally by major companies that shut in much of their heavy oil production last year when over supply and reduced demand conditions existed.

Exploratory drilling in heavy oil territory, as for example the San Ardo area of Monterey County, and some drilling in existing heavy oil fields, currently is showing an increase.

Contributing to this increased activity are the higher prices currently posted by major oil company purchasers for these crudes. Since June 29, prices of the heavier grades of crude have increased a maximum of 35 cents per barrel, with the greatest increase starting at the lower gravities and tapering off to zero at the 25-degree gravity point.

Industry's 1950 Earnings May Exceed Last Year's

Earnings in the oil industry in 1950 may show considerable improvement over those of 1949. In the first six months of this year, 44 oil companies reported aggregate net income of $888,158,000, an increase of 1 percent over the total of $879,869,000 earned in first half of 1949, a tabulation by Carl H. Pforzheimer & Company, New York, revealed.

This increase occurred in spite of a decline of 12 percent in first quarter profits, compared with a year earlier. It reflected improvement in petroleum product prices and continued strong demand during the second quarter, when oil company earnings increased approximately 16 percent.

Total demand for all oils (domestic plus imports) during the first half of this year averaged 6,577,000 barrels daily, or 10 percent higher than in the corresponding period last year.

Independents Continue Campaign Against FPC

Independent Oil and gas producers, facing the threat of control by Federal Power Commission, watch with troubled eyes the developments in FPC's moves toward this objective.

Texas Independent Producers & Royalty Owners Association and more than 2000 individual independent producers and royalty owners have joined in a petition to FPC. They asked the right to intervene in a proceeding against Phillips Petroleum Company in which FPC contends it has the right to fix field prices of natural gas sold by Phillips to interstate pipe lines. FPC set October 9 as the date for a hearing at Bartlesville, Okla., having postponed a hearing to allow more time for preparation by its own and company witnesses. The independent operators will seek to prevent FPC from issuing any order that would apply to field sales of gas made by independents.

Although jurisdiction over independent production and gathering of natural gas was denied FPC specifically in the Natural Gas Act of 1938, the commission has sought to assert such power. Congress undertook to stop this usurpation of powers denied by law, first by the Rizley-Moore Bill, later the Priest Bill, and most recently the Kerr-Harris Bill.

Against strong pressure aroused by false and prejudicial reports to Northern consumers, the Kerr Bill passed, only to be vetoed by President Truman to appease pressure groups in pivotal political areas.

Given this all-clear signal to extend its jurisdiction beyond legal limits, the FPC majority quickly rescinded its own previous order giving assurance that it would not undertake control of independent producers. Phillips Petroleum Company, because its size and reputation would court prejudice for an FPC victory, was selected as the test case.

The independent producers and royalty owners hope to upset the carefully planned FPC propaganda designed to convince the public that only large and powerful companies are hurt by its attacks. TIPRO members, by petitioning for intervention rights in such large numbers, have demonstrated that arbitrary federal price fixing injures small suppliers of gas and land and royalty owners much more than the few large companies. Of the 2037 independent producers and royalty owners that joined in the intervention petition, 400 were from 35 states other than Texas.

Registration of Vehicles To Make 8.5 Percent Gain

Registrations of motor vehicles, including automobiles, trucks, and busses in the U. S. will reach 48,484,000 in 1950, an increase of 3,814,000 vehicles or 8.5 percent over the record total of 44,670,588 registered in 1949, the Bureau of Public Roads has estimated. (The 1949 total had been 3,533,570 above that of 41,137,018 registered in 1948.)

Registrations of passenger cars will jump in 1950 to 39,710,000, an increase of nearly 3,300,000 automobiles or 9 percent from the 36,433,674 registered in 1949, the bureau predicted. Truck and bus registrations are expected to increase in 1950 to 8,774,000, a gain of more than 500,000 or 6.5 percent over the 1949 total of 8,236,914, which included 8,028,016 trucks and 208,898 busses.

The bureau showed that motor vehicle registrations totaled only 468,500 in 1910, jumped to 9,239,161 in 1920, to 26,531,999 in 1930, to 32,035,424 in 1940, and will reach 48,484,000 in 1950.

Despite the large volume of production in postwar years, potential demand for motor vehicles remains high, it is indicated by statistics in the recently issued 30th edition of the Automobile Manufacturers Association's yearbook, *Automobile Facts and Figures.*

As of July 1, 1949, 42 percent of the automobiles in use were ten years of age or older, compared with 17 percent in 1941. The average age of cars in use was 8.5 years, compared with 5.5 years in 1941. In the case of motor trucks, 33 percent were 10 years or older, compared with 18 percent in 1941. The average age of trucks in use was 7.4 years in 1949 and 5.6 years in 1941.

IPAA Group to Consider Oil Field Pipe Scarcity

Suggestions will be offered for alleviating scarcity of oil field pipe when a committee of the Independent Petroleum Association of America makes a report on the subject to the association at its annual meeting in St. Louis October 2-3.

A survey by the committee showed supply of tubular goods tight, deliveries delayed, procurement more difficult, and shortages and maldistribution developing.

Following a conference with 21 steel industry representatives at mid-September, Secretary of Commerce Sawyer made some statements of an optimistic nature on ability of the steel industry to meet defense and essential industry requirements. He said the industry now has a production capacity of 7 million tons per year greater than at the peak of World War II, while the supply situation would be alleviated by present availability of new facilities such as ships and factories that had to be built, using construction steel, during the last war.

It is possible, however, said Sawyer, that the nation will need even greater steel production, and he asked the steel men to submit statements on what they are prepared to do toward increasing steel production capacity.

Senate Finance Leader Promises Tax on Co-ops

Senator Walter F. George, chairman of the Senate Finance Committee, has definitely promised that cooperatives will be taxed in 1951. The promise was made during hearings on the 1950 tax bill when Senator John J. Williams of Delaware proposed an amendment taxing nonprofit organizations. George persuaded Williams to withdraw the amendment after the Finance Committee chairman said: "I myself think we should strive to impose an appropriate tax provision so far as cooperatives are concerned. There are appropriate steps which should be taken to tax them, and that will be done in the next tax bill."

Temporary Tidelands Settlement Delayed

All hope for temporary settlement of the tidelands issue between the federal government and the states is lost until next year. Secretary of the Interior Oscar Chapman has decided to take no action whatever in the controversy until after the Supreme Court passes on the rehearing petition of Texas. It is accepted as virtually certain that the court will reject the Texas petition and enter final decrees against both Texas and Louisiana.

At that point Secretary Chapman intends to step in and draft a stipulation along lines of the recently renewed California agreement permitting continued operation on offshore Louisiana leases. However, since no exploration or producing activity currently is taking place off the Texas coast, Chapman will seek some method to make possible a resumption of work there.

Last hope was abandoned for any interim agreement — pending the Supreme Court decision—when Congressional leaders indicated they would forego further efforts to stopgap legislation. Another last minute compromise plan failed when a proposal by Senator Russell Long of Louisiana failed to win approval of Secretary Chapman. Long put forward a plan for immediately demarking inland waters from coastal seas, thus fixing an area in which private operators could continue work under state leases. Long made clear that he still felt that Chapman should confirm "all valid existing state leases," but said the Interior Secretary was unwilling to do that.

Long expressed the opinion that both Texas and Louisian would accept the arrangement made in the California case by which the federal government would hold in escrow all funds paid in on tidelands work pending final Supreme Court decision.

U. S. Loan Is Indirect Aid To Mexican Petroleum

Indirectly, the government of Mexico has obtained from the U. S. government a loan for expanding its nationalized petroleum industry. No part of the $150 million loan made recently by the U. S. Export-Import Bank is earmarked for oil development. But the loan will free substantial Mexican government revenue that otherwise would have had to be used for non-oil projects and permit it to be devoted to oil industry use.

The loan, stated President Aleman of Mexico to the Mexican Congress, "will be used in credits applied to specific projects for the improvement and extension of railways and highways, future promotion of agriculture, for irrigation projects, for the production of electric power and for power lines, and for the enlargement of telecommunications in the nation."

American oil companies, majors and independents, had actively opposed lending money to Mexico for oil development. They asserted that U. S. private capital would help develop Mexico's oil if the industry were re-opened to private enterprise as in the U. S.

While indirectly promoting the expropriated and socialized Mexican oil industry, the loan also will directly support the Mexican government in its nationalized railway system, aid its government production of electric power, and further state control of communications, thus helping to finance for Mexico a program of socialization similar to that in effect in Great Britain.

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Completions

Again Set Record

AUGUST was the second month in a row when the nation's drillers set an all-time record in the number of wells completed in a single month. In July wells completed totaled 4011 for a new record at the time, but that was topped slightly during August and the new peak is now 4016 wells.

Unprecedented drilling rates of the past several months have boosted this year's completed well total to 28,422, which was 11.6 percent higher than the 25,458 drilled in the first eight months of last year. That total was also 12 percent higher than the number of wells completed by the end of August of 1948, the year that still holds the drilling record.

The gain in this year's drilling campaign has been even a little greater when the amount of footage drilled is considered. So far 103,151,349 feet have been drilled in this year's wells, while a year ago the total had been 90,898,346 feet. That was an increase of 11.9 percent in footage drilled, while the number of wells had increased 11.6 percent.

Of the 2964 increase in wells drilled in the U. S., 1766 were drilled in Texas. Activity in that state has risen 18.9 percent over last year's rate, and at the end of eight months completed wells totaled 11,108 against 9342 a year ago.

Oklahoma has shown an even greater percentage increase than Texas. Wells completed totaled 3466 in Oklahoma, while a year ago 2832 were recorded. That was a gain of 22.4 percent.

Kansas was also up with the large gainers. That state's drilling gained 28.7 percent as 2511 wells have been completed this year and a year ago there were 560 wells less.

Well Completions in the United States During August, 1950, and Cumulative for Year

(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana from Indian Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon and Allegany fields of Pennsylvania and New York from the *Producers Monthly*.)

STATE or DISTRICT	MONTHLY COMPLETIONS, AUGUST, 1950 — NEW WELLS: Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New	Total Drilled Deeper	TOTAL COMPLETIONS: Aug., 1950	July, 1950	Aug., 1949	Footage Aug., 1950	CUMULATIVE TOTAL January-August: Wells 1950	Wells 1949	Percent Diff.	Footage 1950	Footage 1949	Rigs in Operation (Drilling, Rigging Up and Shut Down): Aug. 31, 1950	July 31, 1950	Aug. 31, 1949
Alabama	4			2				6		6	5	1	19,037	30	11	+ 172.7	116,819	57,941	8	4	3
Arizona									1	1	3		1,494	4	4		15,597	11,496	4	5	5
Arkansas	23		1	14				38		38	40	31	136,728	264	211	+ 25.1	884,138	883,485	29	26	31
California	98		4	45				147	13	160	184	169	621,529	1,248	1,700	— 26.6	5,030,693	6,810,401	242	210	265
Colorado	4		1	7				12		12	11	10	55,775	42	45	— 6.7	163,109	200,503	15	17	17
Florida				1				1		1		2	6,598	10	12	— 16.7	65,685	77,278	2	2	4
Georgia														3	4	— 25.0	13,270	12,437			1
Idaho														3			8,540		3	3	
Illinois	132		2	160				294		294	340	245	690,899	1,808	1,641	+ 9.8	3,918,194	4,063,877	263	274	237
Indiana	54		7	99	1		1	162		162	160	115	297,726	1,042	782	+ 33.2	1,811,874	1,456,811	198	210	139
Kansas	137		31	130			2	300		300	386	279	964,134	2,511	1,951	+ 28.7	8,104,792	6,497,482	348	362	280
Kentucky	58		19	65				142		142	144	88	264,879	772	595	+ 29.7	1,404,221	1,075,922	112	116	93
Louisiana	120	15	20	76				231	1	233	207	241	1,313,397	1,620	1,453	+ 11.5	9,746,641	8,059,178	242	234	196
North Louisiana	76	8	18	46				148		148	106	180	488,975	864	841	+ 2.7	3,009,497	2,733,717	70	75	60
South Louisiana	44	7	2	30				83	2	85	101	61	824,422	756	612	+ 23.5	6,737,144	5,325,461	172	159	136
Maryland														1			3,612		2	2	
Michigan	29		1	43				73		73	79	60	178,324	535	579	— 7.6	1,267,049	1,304,455	147	145	136
Mississippi	4	5		16				25		25	30	30	157,576	235	228	+ 3.1	1,690,686	1,677,538	25	26	33
Missouri											1	2		23	14	+ 64.3	14,585	7,002	7	6	
Montana	37		2	17				56		56	12	27	120,845	173	168	+ 3.0	442,200	433,195	39	42	52
Nebraska	4		1	5				10		10	11	2	45,332	58	5	+1060.0	243,154	19,216	12	12	3
Nevada																			2	1	
New Mexico	32		7	20				59	2	61	55	45	261,632	411	346	+ 18.8	1,813,034	1,501,303	95	98	91
New York	56				35			91		91	80	76	126,445	512	667	— 23.2	761,204	941,265	114	99	103
North Dakota																			4	2	3
Ohio	33		20	29				82	4	86	90	112	168,811	636	707	— 10.0	1,319,722	1,527,983	157	148	164
Oklahoma	239	1	24	158	2			424	6	430	440	417	1,670,185	3,466	2,832	+ 22.4	12,157,435	10,126,523	644	619	499
Oregon																			1	1	
Pennsylvania	56		28	9	53	8		154	2	156	155	188	282,214	1,074	1,399	— 23.2	1,947,423	2,508,847	263	263	264
South Dakota				2				2		2			6,670	3	2	+ 50.0	12,380	6,905	1	1	3
Tennessee												4		3	18	— 83.3	3,993	23,489	8	9	6
Texas	931	21	83	475	1	3		1,514	35	1,549	1,455	1,124	6,668,830	11,108	9,342	+ 18.9	47,184,733	38,694,131	1,487	1,425	1,150
Dist. 1 S. Central	29	1		24				54		54	36	50	167,849	324	385	— 15.8	904,583	1,145,732	39	28	34
Dist. 2 Middle Gulf	32	1	11	28				72	1	73	62	54	412,858	451	443	+ 1.8	2,598,434	2,598,046	54	57	50
Dist. 3 Upper Gulf	75	6	5	55		1		142		142	139	116	841,740	1,052	899	+ 17.0	6,154,176	5,444,480	130	129	110
Dist. 4 L. Gulf-S.W.	77	5	10	63				155	5	160	121	87	792,505	1,111	920	+ 20.8	5,329,731	4,570,440	131	101	98
Dist. 5 E. Central	6	2		14				22		22	16	9	113,964	136	141	— 3.5	581,196	659,924	16	21	15
Dist. 6 Northeast	42	4	4	14				64		64	50	74	328,933	425	619	— 31.3	2,055,858	2,702,362	32	39	41
Dist. 7-B N. Central	86		4	81		1		172	2	174	193	154	500,433	1,302	1,291	+ 0.9	3,662,849	3,840,258	116	126	160
Dist. 7-C W.Central	57	2	2	42				103	9	112	88	41	362,222	610	301	+ 102.7	2,461,231	1,403,832	96	89	82
Dist. 8 West	342			48	1			391	16	407	395	251	2,135,785	2,829	1,902	+ 48.7	15,183,915	9,312,083	563	514	324
Dist. 9 North	126		1	99		1		227	2	229	291	230	668,377	2,195	1,731	+ 26.8	6,131,994	4,712,506	211	220	140
Dist. 10 Panhandle	59		46	7				112		112	64	58	344,164	673	710	— 5.2	2,120,766	2,304,468	99	101	96
Utah				4				4		4	1	6	9,251	14	37	— 62.2	39,685	175,007	8	9	14
Virginia																			1	1	
Washington														2			16,032				
West Virginia	7		39	17				63	1	64	65	40	173,220	428	308	+ 39.0	1,079,996	889,327	265	260	231
Wyoming	34		1	22				57	3	60	57	50	272,402	383	397	— 3.5	1,870,853	1,855,349	83	80	90
Total U. S.	2,092	42	291	1,416	92	11	3	3,947	69	4,016	4,011	3,364	14,513,933	28,422	25,458	+ 11.6	103,151,349	90,898,346	4,831	4,712	4,118

Let the people know:

API Public Relations Program Sells Free Enterprise System

An interview with

JOHN M. LOVEJOY

President, Seaboard Oil Company of Delaware

EDITOR'S NOTE: *In this interview, John M. Lovejoy, president of Seaboard Oil Company of Delaware, represents the hundreds of American oil men who have given freely of their time and energy to further good relations between the petroleum industry and the public which buys its goods. Chairman of the Public Relations Committee of the API board of directors, Lovejoy has been a director of the association since 1934. He has been active continuously against federal encroachment on the industry, and in 1940 headed a group of witnesses for oil producing states which registered the industry's objections to an oil control bill before the House Interstate Commerce Committee. He was elected president of Seaboard in 1930, and has also served since that time as a member of the board of directors.*

Q. *How and when was the oil industry public relations program initiated?*

A. The program originated in the spring of 1946, when the Board of Directors of the American Petroleum Institute became convinced that the oil men of this country must tell the story of their industry and of the free enterprise system to the people of America. Accordingly, the Oil Industry Information Committee was created to develop and operate such a program.

Q. *What is the program's objective?*

A. The objective of the program is to help reaffirm the faith of the American people that their individual interests, as well as those of the nation, are best served by competitive, privately-managed oil companies. It has been established as a long-range educational effort to bring the facts about the oil industry's operations to the public, working through the American Petroleum Institute in cooperation with oil companies, trade associations, and other groups and individuals. The program is both nation- and industry-wide—in other words, we do not concern ourselves either with specifically local problems or with matters affecting only one group or segment of the industry. We have taken the oil industry as an example of what American initiative and enterprise can accomplish when left free from bureaucratic controls. We are attempting to show how the successful operation of industry depends on the working of a free market.

Q. *What is your organizational structure?*

A. For operating purposes we have divided the country into districts, each headed by a local chairman and staffed by one or more field representatives. Each district, in turn, is made up of local committees organized at the state, regional, area and community levels. You can get some idea of the response which the program is receiving in the field when I tell you that there are now 3500 community committees totaling more than 10,000 members. Even these figures do not give a true indication of the support we are getting, as there are literally thousands of oil men who join in committee activities but who are not yet formally committee members.

Q. *Just how does the program operate?*

A. The Oil Industry Information Committee's activities can be said to fall into 3 broad classifications: field work, editorial-research, and advertising. The coverage of the "grass roots" program is tremendous: for example, from January 1 to July 1 of this year, oil men held 30,000 showings of company and OIIC movies before a total audience of nearly 5 million people, gave 1100 speeches before 95,300 people, and displayed more than 400 exhibits which were seen by an estimated 1 million people. This, of course, does not include the very considerable activities of local oil men in arranging for the placement of news and feature stories, appearing on broadcasts and telecasts, arranging open houses and plant tours, and handling such major events as Oil Progress Week. The program's administrative, editorial and research staffs are headquar-

tered in New York. Here our various activities are coordinated, and the necessary printed materials prepared and distributed. The committee's full-page advertisements carrying the program's message appear each month in 4 leading national magazines, and in addition several companies have adopted our campaign as a part of their own advertising programs. Thus, the effect of our work is a continuous, day-to-day impact upon the entire American public—an impact that is growing constantly in strength and force.

Q. *Does the program include all elements of the oil industry?*

A. Most certainly. Committee activities are designed to benefit all—the producer, the refiner, the transporter and the marketer. There have been a few isolated cases in which jobbers or dealers have indicated that they did not understand one of the program's basic principles, and although these instances are becoming more and more infrequent, I should like to clear the point up. Inasmuch as our efforts are dedicated to advancing the interests of the entire industry, we cannot take sides on such issues as margins or imports, nor can we attempt to referee arguments between jobbers and suppliers or between jobbers and dealers. I believe that when those jobbers who hitherto have shown signs of reluctance grasp this point they will quickly join in the program. I know of no jobbers' association in the country which has taken issue with the committee regarding either its objectives or its operating principles, and I am confident that in a short time we will gain the wholehearted support of every association.

Q. *Are you doing anything in the schools?*

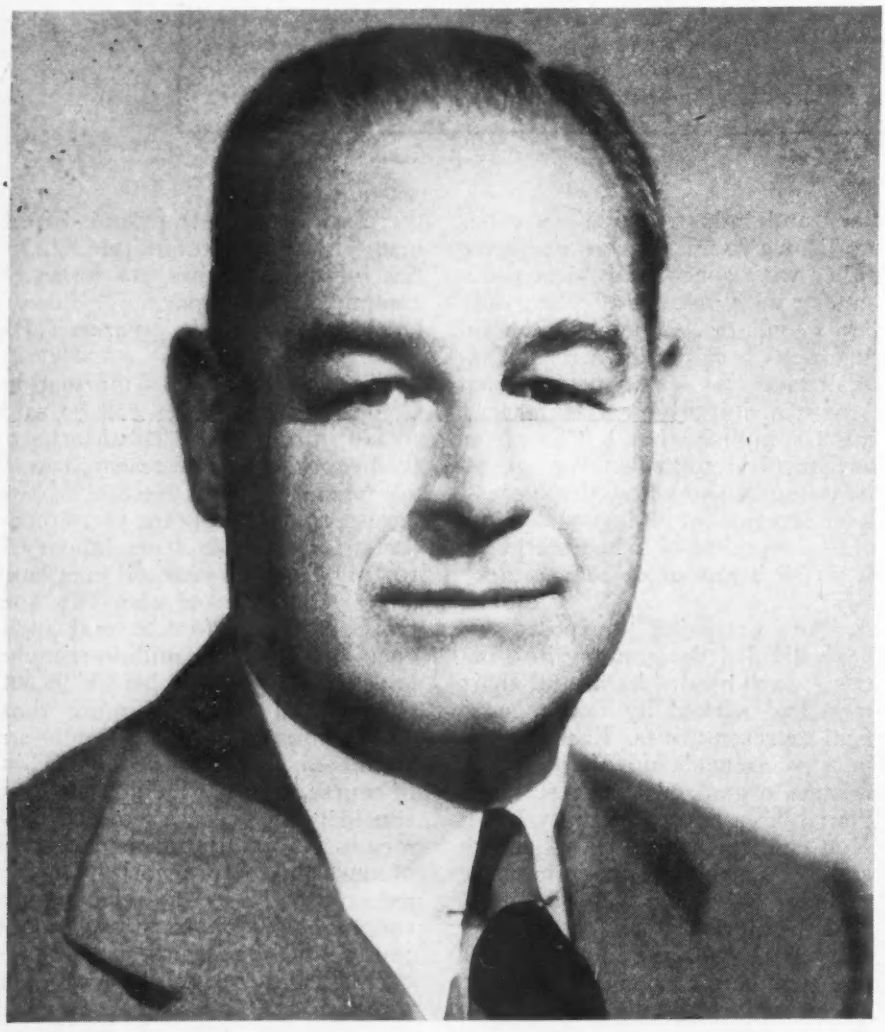
A. Yes. Early this year the committee undertook a study of school needs and school opportunities in 2 counties of each of 2 states. With these findings to guide us, we are currently preparing a series of materials for school use, and these will be shortly tested in "pilot plant" projects in 24 counties throughout the country. Interviews will then be conducted with teachers and principals in each area tested, and the resulting suggestions incorporated. After these preliminary surveys and preparations, the program will be developed on a nationwide basis. Of course, this is a major, integrated project, but we have been active in school work from the beginning. Our field organization has arranged for countless film showings for students, for example, and we have distributed tens of thousands of charts and brochures on every aspect of the industry. We are keenly aware of the importance of getting our story before the young people of this country.

Q. *Does the program deal with legislative matters?*

A. No. Such activities would be at variance with the committee's policies. You will find in the committee's Statement of Operating Principles the following: "Information thus disseminated will be for the benefit of the American oil industry as a whole, confined to subjects upon which all segments of the industry are in general agreement. No attempt will be made to influence industry operating policies or practices, nor will any information be disseminated or activity undertaken which will tend to lessen competition within the industry."

Q. *In your opinion, what has been the program's most important contribution?*

A. Neither I nor any other person associated with this program feels sanctimonious about the work we are doing, but we are firm in the belief that it is one of the most important and most needed jobs in the country today. As I see it, that job is to remind the American public of what has made this country great, what makes it worth living and fighting for—why it is "the last best hope of earth." The men in this program know that they're not selling oil. They've got a bigger product — the ideas and fundamentals that made the oil industry and all of our industries possible. The oil men associated with this committee have been selling those ideas and fundamentals for nearly 4 years. I believe that the public is better informed regarding the oil industry as a result of this program—and an informed public is our best guarantee for continued progress in this great industry.



JOHN M. LOVEJOY

Planned Oil Field Building to Reduce Costs

By GEORGE VERNON RUSSELL
Russell & Samaniego, Industrial Architects, Los Angeles

FIGURE 1. Spotting of office equipment, desks of employes, telephones, etc., must be considered with the same care as would be given the placing of a production or service machine in a plant. Such considerations must be weighed well in advance of plans for the shell of the building, and only after careful study of the company organization chart and traffic flow diagrams.

BY DESIGNING and engineering architecturally from the inside out—whether it be for an office building, a warehouse, a pipe yard or even a whole community—the initial cost, as well as the long-term cost, of operation and maintenance can be greatly reduced.

If building costs and subsequent operation costs are to be held at a low level, any industrial building project must be engineered by the same methods as a machine is designed; that is, preliminary study of operational needs, coordination of movements, and finally the housing. Such planning is logically the work of an architect-engineer with broad experience in adapting the functions of architectural planning to the needs of modern industry. The conditions under which many installations in the petroleum industry are set up call particularly for specialized knowledge and preliminary study of the client's needs.

Choice of Site

If possible, the architect's work should begin with the choice of a site.

The layman may raise the question as to what the architect would have to do with the choice of a building site. The answer lies in the fact that only a competent architect, with previous experience with grades, traffic, drainage, zoning setbacks and many other important considerations, is qualified to pass upon this very important beginning for any industrial building project. And, if it is an oil field installation, located miles from nowhere, the architect's expert choice of a site may mean the difference between efficient and trouble-free operation and an endless program of operating the hard way.

But whether the site is to be in Saudi Arabia or in the heart of a city, there are definite considerations which enter into the choice of location for every efficiently engineered building project. The following list will give an idea of the main factors which should influence the proper choice. All these, in one way or another, have a direct bearing on building costs, the future efficiency of the plant, and its over-all cost of operation. The factors to be considered are:

Location central to principal activities of the company.
Transport: Rail and truck routes.
Housing for employes.
Grade conditions which might affect building costs.
Exposure and daylight conditions.

IN THE oil industry, as in other industries, important advantages and savings can be achieved through scientific planning of buildings or groups of buildings. By designing and engineering the building architecturally, from the inside out, the industrial architect can reduce initial building costs through carefully detailed plans, and also can lower long-term costs of operation and maintenance by providing for efficient and convenient functioning of workers and equipment.

Proximity of plant to storm drains.
Soil conditions and foundation bearing values.
Zoning ordinances if any.
Water supply, especially for fire protection.
Public utilities offered.
Comparative land values.

Oil Industry Applications

In planning and engineering a recent building project for a large oil field supply company and another one for a major oil company, all the above factors, when considered, were the means of materially reducing building costs and making an efficient installation. On one of our current commissions, which involves the planning of an entire oil field community, the choice of the site was influenced by the fact that the project was begun by building a 4000-foot airstrip with service buildings. These consisted of an administration building, a garage repair building, and a change building. In this case, it is at once apparent that such an extensive site involved careful consideration by the architect of the factors listed above, and others as well, in order to coordinate them all properly.

Studying the Client's Needs

For this discussion, assume that the site for a building project has been properly chosen. The next move on the part of the architect is a preliminary study of the client's business operations as they appertain to such activities as paper work, traffic flow, shipping, warehousing, and storage, and the handling of materials and supplies. Until this study has been made, and the data correlated, there is no good reason for submitting sketches or plans of any sort; for, without definite operational data behind them, plans would be nothing but an idle gesture.

In the case of the supply company project mentioned above, where the planning involved problems of storage, warehousing and shipping, with the attendant paper work, it required several months of study by a staff of our analysts and technicians installed in their plant, before we were ready to submit plans. But the savings in subsequent building and operation costs were enormous.

Organization Chart

The company's organization chart is the first source of information about their methods of operation. From this the relationship of the various departments can be determined and locations planned for a convenient and efficient flow of work from one to another. Study of this chart is the beginning of a thorough study of the traffic flow among all departments. This should be the foundation of all industrial architectural planning.

Since an industrial plant is virtually a production or service machine, it must be engineered to work like one if costs are to be held at the lowest possible level. Such considerations as the spotting of office equipment, the desks of employes (Figure 1), and other factors must be weighed well in advance of plans for the shell that houses them; therefore, as soon as the department locations are decided upon from a study of the organization chart, the study of traffic flow begins.

Consultation with Employes

The best source of working data for this part of the preliminary study lies in the answers to questions put to the departmental employes who actually do the work. This practice not only uncovers valuable suggestions for efficient operation, but it has a definite industrial relations value as well. The employe who has been consulted feels more inclined to make the system function, and inefficient practices which might otherwise never come to the direct attention of the management are uncovered and rectified.

In the warehouse and shipping departments, such questions as the following should be asked and the answers tabulated for application to the architectural plans: How does the bulk of the receiving come in? What weights are involved in handling materials? What binning facilities will be required for supplies?

These are the types of questions which should be asked in all departments and categories of operation. The rolling stock, both that of the company, and the equipment suppliers, should be studied and tabulated. These data will establish the varying heights of the shipping docks to accommodate this equipment. Shipping dock layout (Figure 2) planned to eliminate right-hand backing will save the time of the man usually required to direct the driver from the ground. In the heavy storage area, the spotting of cranes to handle such material must be considered in relationship to the over-all operation of the plant, as well as the shipping department.

The location of the administrative offices for easy access to shop, warehouse and shipping activities must be considered, as well as many other pertinent factors; and all of the attendant data carefully tabulated in a form from which a traffic-flow pattern can be developed.

Figure 3 is offered for a clearer understanding of the process by which final plans are evolved.

The consecutive steps necessary to obtain the final result are recapitulated as follows:

1. From the conventional type of organization chart shown in the first box, the relationship of the various executives and their departments is noted and their convenient location needs studied.
2. The operation of all departments is then studied direct, and the number of persons in each is tabulated to determine space requirements.
3. From the above and other factors, the actual space requirements of each

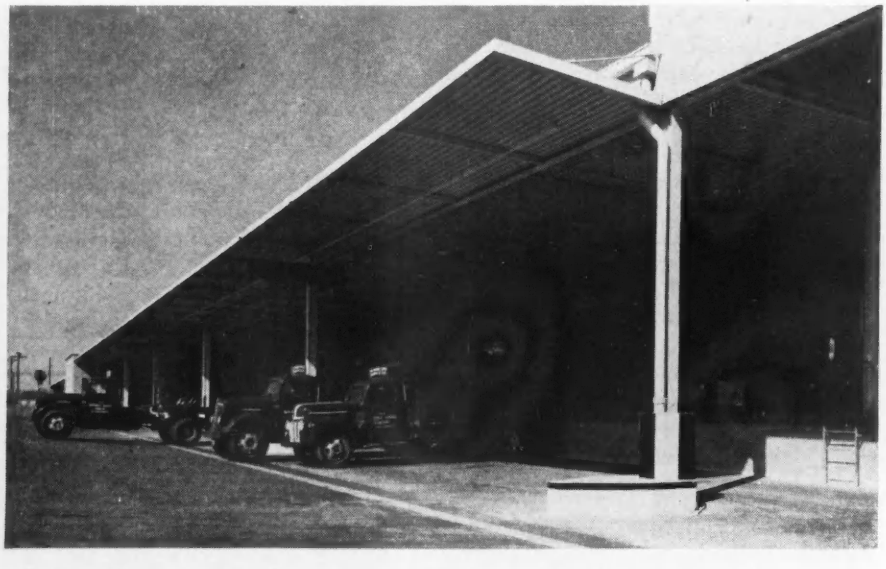
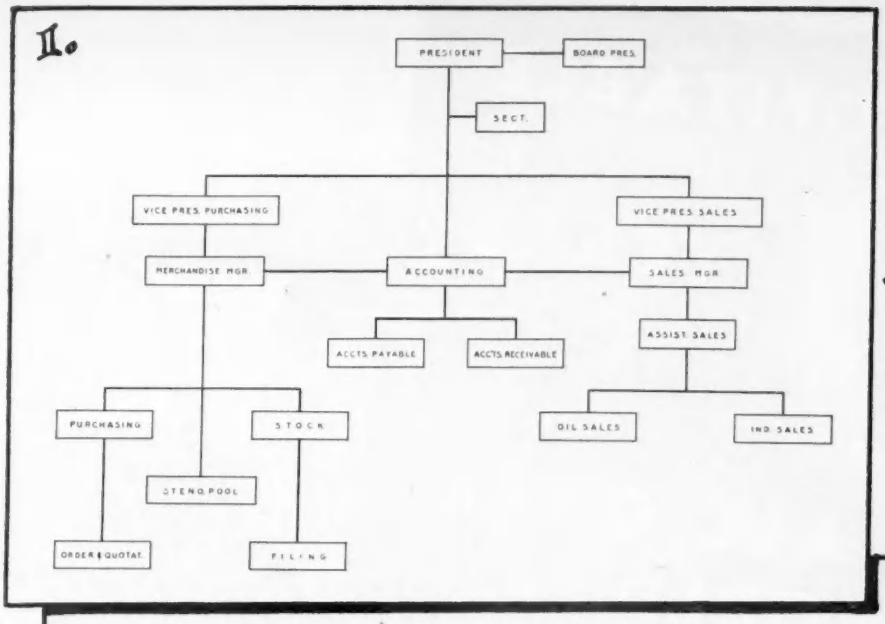


FIGURE 2. Shipping and receiving docks are laid out so that all types of trucking equipment can be accommodated and, more important, so as to eliminate right-hand backing which would require assistance of a man on the ground to direct the driver.

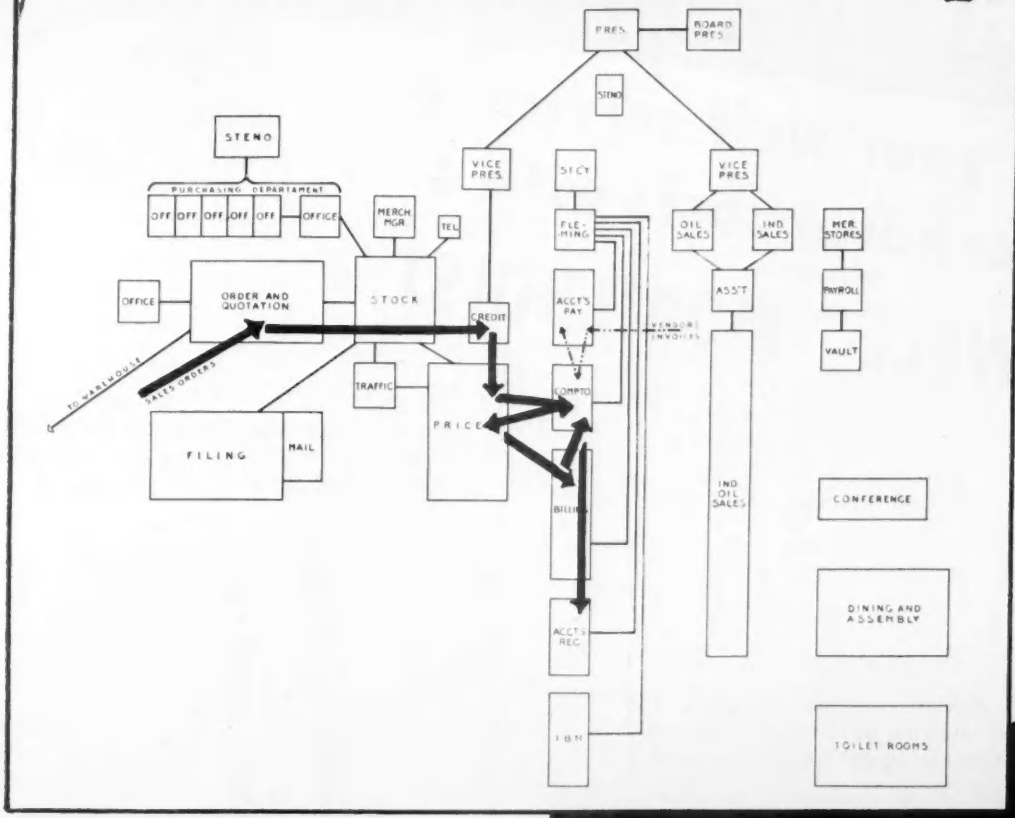
1.



From this

From the type of organization chart at the left, the relationship of the various executives and their departments is determined. From this data, the relative location of these departments is established from the standpoint of efficiency and convenience.

2.



Comes this

Space requirements of each department have been calculated and dimensions established on the chart. The black traffic flow lines guide the architects in the final arrangement of the floor plans.

3.

Which determines layout of this

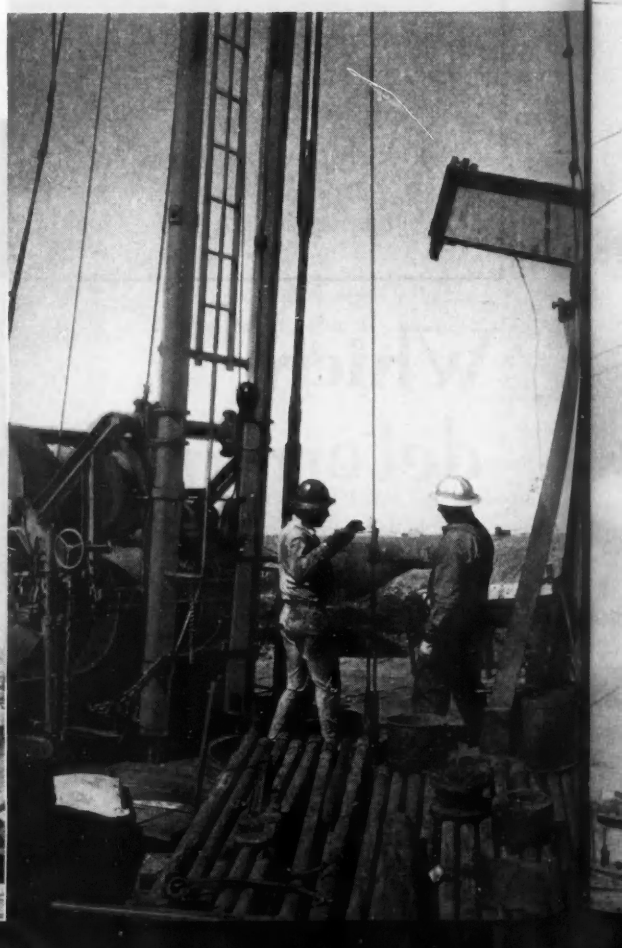
The data collected by the preliminary study, with that developed from the two charts above, is finally coordinated and expressed in the general plant layout and floor plan which culminates in a completed project like that shown at the right.

FIGURE 3

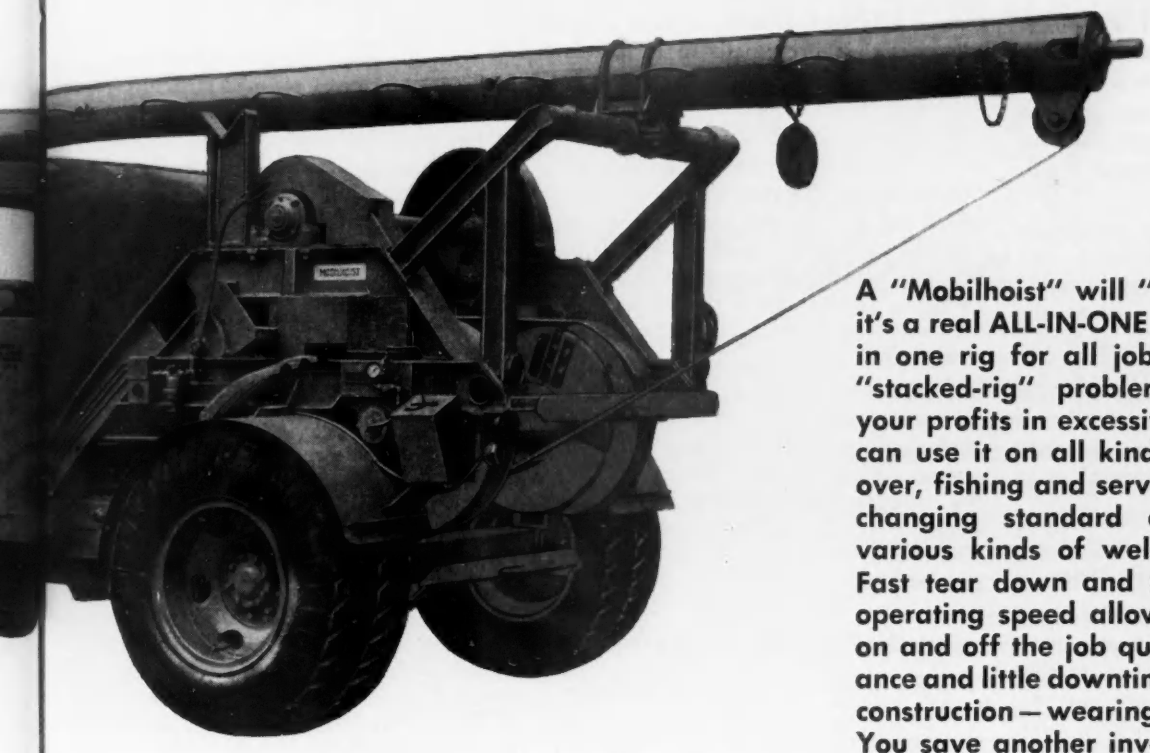
PROVED PROFITABLE FOR 10 YEARS BY USERS ALL OVER THE WORLD

reduce your well servicing and workover costs with a CARDWELL "MOBILHOIST"

Pulling rods and tubing from a 4,000-foot well. Only two men are needed because of the convenient ground location of controls.



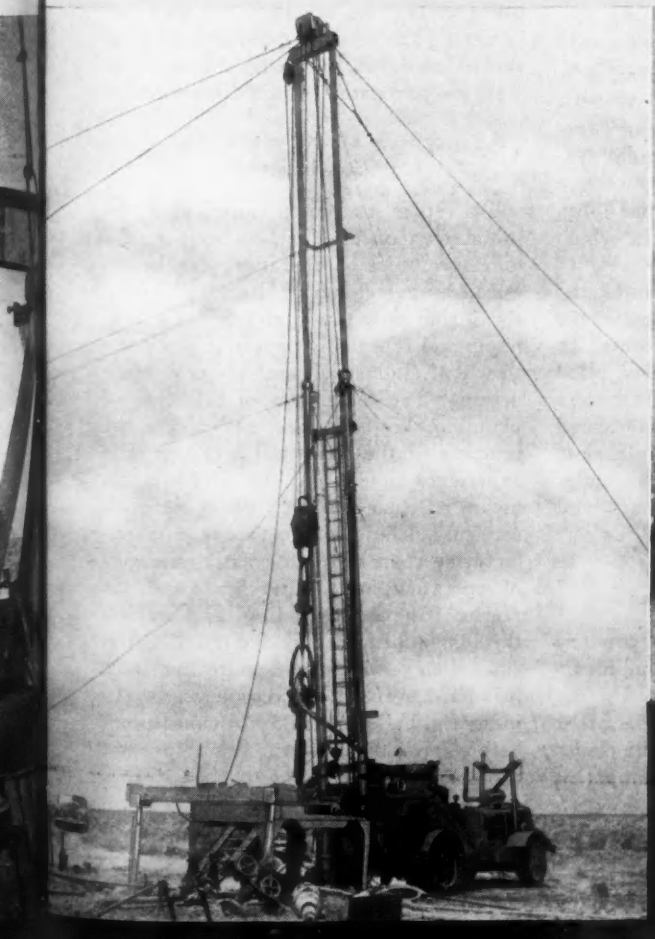
"Mobilhoist" with jerkline spudder deepening a 3,300-foot well. Air controls operate the Cardwell Air Disc friction clutches in upper and lower drums.



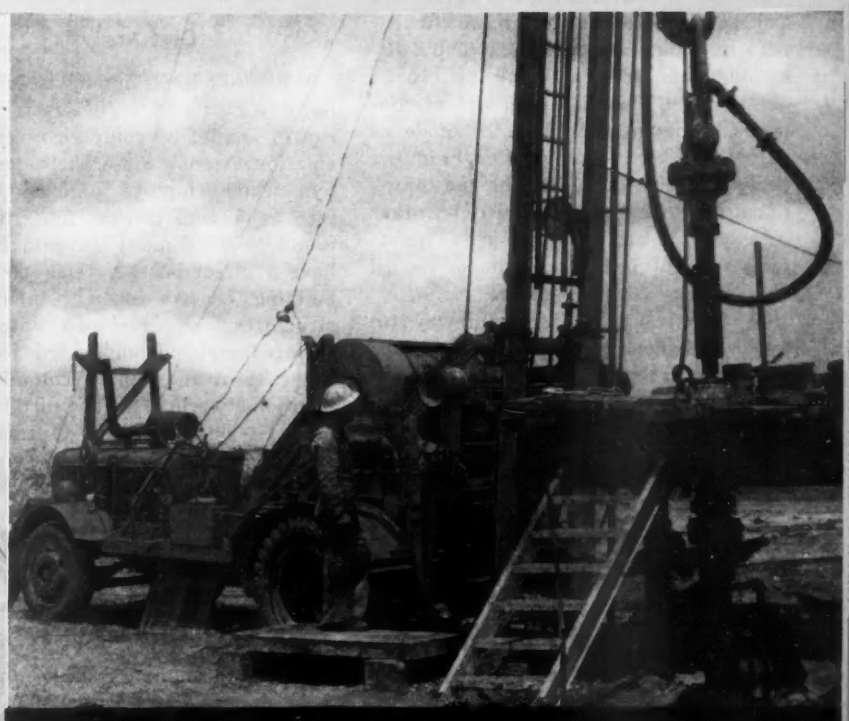
A "Mobilhoist" will "Buy Itself" because it's a real ALL-IN-ONE rig. One investment in one rig for all jobs. It eliminates the "stacked-rig" problem that eats away your profits in excessive fixed assets. You can use it on all kinds of drilling, workover, fishing and servicing jobs by simply changing standard attachments to do various kinds of well work.

Fast tear down and rig up, and its fast operating speed allows your men to get on and off the job quicker. Low maintenance and little downtime, due to alloy steel construction — wearing parts heat-treated. You save another investment in an extra rig, extra crew, plus additional tax expense, with the ALL-IN-ONE "Mobilhoist." *Write for prices and "Mobilhoist" catalog.*

Fast moves and quick set-ups make the "Mobilhoist" ideal for reverse circulation jobs. Rotary table drive is interchangeable with spudder.



Using 2⅞" drill pipe, this double drum "Mobilhoist" with rotary table drive assembly is deepening a well on the Gulf Coast. Complete rig-up with 55-foot double leg mast was accomplished in less than two hours.



CARDWELL MFG. CO. INC.

P. O. Drawer 2001 . . . Long Distance Telephones 128—129—130
Cable Address: "ALL STEEL," Wichita — "CARDSTEEL," New York
Wichita, Kansas, U. S. A.

department is calculated, the dimensions established, and provision made for possible expansion.

4. The intercommunication of the various offices is studied next, to establish their relative locations.
5. All these data are then expressed in block form for visualization as shown in the second box of the illustration.
6. Finally, the routing and traffic flow of orders, supplies, paperwork, etc., are established by drawing a traffic flow line which passes among the various department blocks, as shown in the second box. This line guides the architects in the final arrangement of the floor plans.

All the above factors are now coordinated and expressed in a general plant layout and floor plan.

Spotting and Orienting Buildings

If there are to be more buildings than one, a study of the traffic-flow pattern will reveal the requirements for spotting them so that the flow of work can proceed from one to the other with a minimum of waste motion.

Coincident with the placement of the buildings there should be a consideration of the daylight conditions, and the buildings should be oriented to take advantage of natural lighting. Proper lighting conditions are a factor which has definite bearing on employe morale, and consequently on efficiency. For that reason alone, the architect must consider them in his plans.

Industrial relations experts agree that a cheerful employe is much more efficient than one annoyed or depressed by disturbing conditions, and lighting can be one of them. Poor lighting, violent contrasts, colors in poor taste, or of definitely negative psychological effect on the occupants of a room, can be the means of cutting down the efficiency of a worker in ways that are hard to trace. The effects show up in his perforamnce record nevertheless.

Modern research has found ways to avoid such negative conditions, and the industrial architect is in a specially advantageous position to make use of industry's research findings in this field and pass them on to the client. The materials manufacturers constantly offer valuable data to architects . . . data which the layman seldom finds available. The architect gathers it and puts it to good use in his plans. The results are reflected in better working spirit and efficiency.

In the average building having office workers, south and west walls, which would naturally receive warm light, can be painted with cool colors, while walls in the north rooms can be finished with warm tints. On the west elevation, where the afternoon sun is likely to be a problem, glare can be reduced and partial shade can be created by the use of exterior fins. Overheating of these exposed rooms is thus prevented. In turn, this effects a saving in the operation of any air-conditioning system.

Daylighting should also be considered in the allotment of the various departmental offices. The steady north and east lights can be reserved for those whose work is most detailed, while the offices of outside men and others who spend only part of the day in the offices, can be located on the south and west.

All these factors being properly correlated, the preliminary plant layout can be made complete enough to provide for such special engineering features as the air-conditioning system, the plumbing, the spotting of telephones, and other accessories to the construction work. The whole concept is then ready for presentation to the client.

Scale Models Versus Flat Drawings

When ready to present a complete concept of a project, it is the practice of this firm to present it in the form of a scale model, rather than in flat drawings. This is the only sure means by which an architect can be certain that a layman understands what he intends to do, and in detail. Flat drawings are likely to create false concepts in the mind of the client, and it can often mean added expense if the architect discovers the misconception too late. With a scale model, a miniature replica of the whole project, there can be no doubt.

Cost Analysis

While the scale model is being prepared, a cost analysis of several systems can be made for comparison and presentation. Among these, the modular system, which employs increments of five feet as a construction unit, has been found to have many advantages which have a direct bearing upon the cost of building. By working with modules, the structures are developed with simple surfaces and uncomplicated forms. In the case of the supply company plant mentioned earlier, the use of this system made it possible to use prefabricated steel panels with precast concrete skin. These showed a 15 percent saving under the cost of conventional masonry and reinforced concrete.

Effect on Insurance Rates

This one economy created a secondary dividend through a reduction in insurance premiums brought about by the choice of materials. It is also a fact that a three-way consultation with the client, the insurance counselor and a competent architect can often develop an insurance formula which will effect permanent savings in premiums, particularly for the long pull.

Up to this point little has been said about the exterior of planned structures, because, in the economical process of building from the inside out, the shell or housing must conform to the needs of the interior layout. The modular system of planning helps to preserve simple lines for the exterior, and a structure so built, needs no false fronts and other afterthoughts to be seen as a complete and pleasing unit.

Letting Out for Bids

When the scale model has been approved, the plans completed, and the project let out for bids, the value of architectural planning and the system of building from the inside out becomes fully apparent. Explicit and detailed specifications, made possible by preliminary study and minutely detailed plans, cut down the differential between high and low bidders to the minimum—as low as 10 percent variation, in our experience. This in turn enables the contractor to know exactly what he must deliver, and consequently to bid the minimum without fear of hidden risks. One of our planned projects, let out for bids under these conditions, ran $50,000 less than the client anticipated.

In addition, the system of careful preliminary study and minute specification is bound to pay off in the absence of the "extras" which plague those who build without proper architectural counsel and preparation. The saving in extras alone is one of the strongest inducements for the industrialist to follow the methods we have advocated in this discussion.

Conclusion

To return to our premise, that the initial cost of building, as well as the long-term cost of operation, can be reduced by designing architecturally from the inside out, this fact has been definitely and repeatedly proven in our practice with industrial architectural engineering. The techniques of this type of planning, however, are exclusively the function of the industrial architect. His experience applied to the problem can mean reduced building costs, through carefully detailed plans, reduced manufacturing costs through greater efficiency of operation and traffic flow, and the reduction of waste time and motion through improved employe morale. And since such services pay definite dividends, it is hard to think of a reason why every industrial builder should not consult him before proceeding with any important project.

Condemnation of Depleted Reservoirs for *Gas Storage*

By BURNS H. ERREBO
Sunray Oil Corporation, Tulsa

UNDERGROUND STORAGE of gas is urgently essential in distribution of the gas, because of seasonally fluctuating consumption. But wide use of underground storage is handicapped by difficulties in acquiring acreage overlying suitable reservoirs at reasonable costs. To solve the problem, it must be possible for gas companies to gain condemnation of required acreage under powers of eminent domain. Both producing and consuming states should approve condemnation of depleted reservoirs for gas storage, where needed in the public interest, making use of their present laws if suitable or passing new laws if necessary. West Virginia, Michigan, and Kentucky recently have passed such laws, whereby gas companies are specifically given the right to condemn depleted and exhausted underground strata for gas storage purposes.

NATURAL gas once was considered merely a waste product of the production of oil and was blown to the air or flared in large quantities. Natural gas has since been found to exist by itself in underground rock formations; and as the supply has become more abundant, its use has become more widespread, until many cities and industries now rely upon gas almost exclusively as a source of fuel.

The market for natural gas has seen a tremendous growth in the past five years. A number of factors contributed to this growth. One is the fact that consumers, both domestic and industrial, have sought a fuel which is clean, easy to utilize, and the supply of which is unaffected by the annual strikes which paralyze other sources, interrupt deliveries, and make continuous plant operation or a warm home in the wintertime a gamble. Another factor in the growth of natural gas sales is its increased availability due to construction of pipe lines. The discovery of such huge reservoirs as the Hugoton field, which extends into Kansas, Texas, and Oklahoma has added reserves which are even yet unestimated. On the other hand, state conservation agencies have shown an increasing concern over the waste of casinghead gas produced with the oil. Such waste has resulted in orders by state regulatory bodies requiring drastic reduction in the amount of gas flared or vented and an increase in the amount of gas available for sale.

The Problem

In the past, gas transmission and distribution have posed vexing problems, some of which still exist. One of the most important of these is that of providing for the seasonal fluctuations in the demand for gas by communities remote from the source of production. So far, this fluctuation has been dealt with by the rather unsatisfactory means of using large capacity lines which must be financed, designed, and built to operate at maximum loads for a few weeks in the winter, but which carry only a fraction of capacity loads the rest of the year. Were the demand for gas stable throughout the year, the problem would not exist. Yet this is not the case. In the coldest days of the winter, the housewife turns on the gas furnace or heaters to full capacity. In the summer, a little gas is used for cooking, and as climatizers; but the heaters and the furnaces are supplanted by fans and air-conditioning units.

Cities in the heart of gas-producing areas are afflicted with this problem as well as those at a distance from the source of supply. From a cursory glance at this situation it might appear that the solution would lie in the construction of larger lines to handle peak demands, but this is not the answer. The larger the line, the larger the investment, and the larger the cost. This means higher prices to the consumer. When gas engineers talk about the average amount of gas which a pipe line carries during the year, they refer to it in terms of its "load factor." They define it as the ratio of the average daily delivery to the maximum possible daily delivery in a year. The higher the load factor, therefore, the sooner the pipe line will pay for itself; the lower the load factor, the longer the payout. Pipe lines which must be built big enough to carry large quantities of gas for a few weeks in the winter and yet which utilize only a part of this capacity the rest of the year are said to have a low load factor.

The Solution

The problem has been effectively met by some public utilities by the storage of gas in depleted gas sands adjacent to the point of consumption. It is impracticable to attempt to store gas in large tanks on the surface, for this method has in the past proven relatively costly and dangerous. So nature's original means of storage is used to hold gas brought in from distant gas fields. The idea of underground storage has thus been conceived and is being successfully carried out. In times of peak load and heavy demand, the underground store of gas, located relatively close to the point of consumption, can

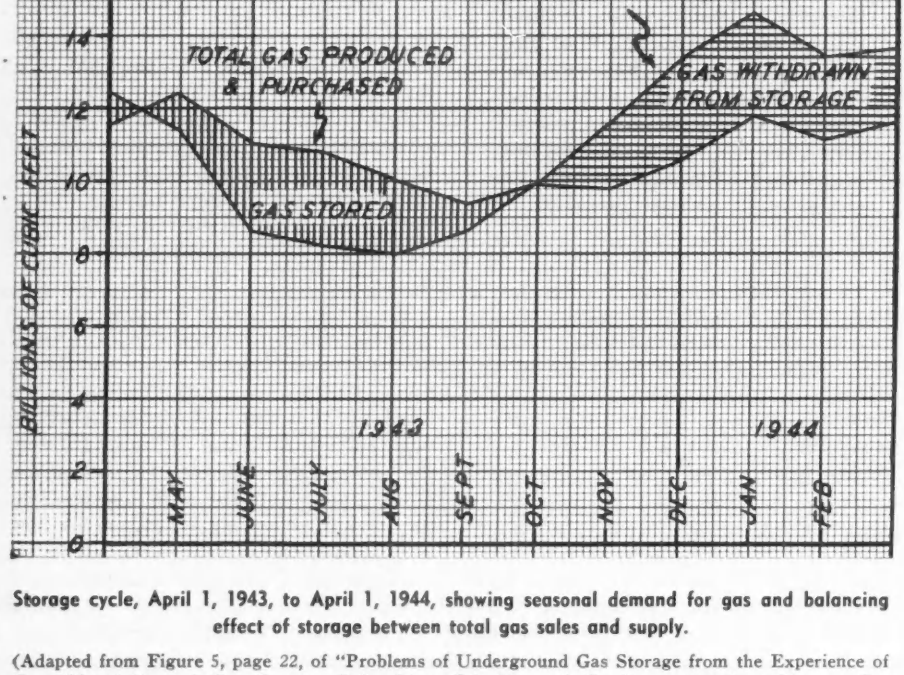
be tapped and an added and sorely needed supply is made available to consumers.

It must be kept in mind that a depleted gas or oil sand must have certain characteristics and attributes to be satisfactory for gas storage purposes. The particular structure selected must have sufficient closure, or if a lense, it must be large enough to provide adequate storage space, and at the same time be small enough that a large capital outlay in gas is not required to provide a sufficient working pressure. The permeability must be enough that gas can either be withdrawn or injected at a convenient rate. Abandoned and plugged wells in the area must have been properly cemented and cased to prevent loss of gas to other formations. The sand must be relatively free of liquids so that no serious problem of removal will be presented.

It is thus apparent that nature has not provided suitable gas storage reservoirs on every hand so that, if one is not available, another may be used. The result is that when one is found which is suitable, it must be utilized. Obviously, all land overlying the structure must be leased. But it often happens that some landowners, knowing that their land is indispensable to the success of a storage project, demand exorbitant prices for leases upon their land. The old law was that a man owned his land from the sky to the center of the earth. This rule has been modified by aviation law to meet the social and economic needs of the present day. But the present state of the law as to gas storage is unsettled, and there is some question as to whether or not a person who injects gas which permeates formations beneath the land of another should be as liable in trespass to him as though the gas were stored in tanks on the surface without permission of the landowner. A Kentucky case held that a person who reinjects gas into a storage reservoir loses title, so that another may withdraw that same gas and, under the rule of capture, become its owner. There might also be a question of wrongful commingling of the injected gas with that in place and a resulting loss of title by the one injecting it.

With these questions confronting gas companies, the bargaining position of a man who owns ten acres in the center of a 1000-acre reservoir is readily apparent. It is also apparent, it follows, that the owner of such a small tract can block a gas distributor in carrying out its public duty of furnishing an adequate gas supply to its coustomers at all times.

The lack of detriment or injury to the recalcitrant landowner is an outstanding characteristic of condemnation of this type of property interest and distinguishes it from instances where a farmer's cornfield is bisected by a new express highway or where town lots are condemned for a site for a new railroad station. Gas stored 1000 or more feet beneath the surface cannot possibly disturb the owner's use of his land. If need be, the surface of a given tract would not have to be touched in an operation of this type.



Storage cycle, April 1, 1943, to April 1, 1944, showing seasonal demand for gas and balancing effect of storage between total gas sales and supply.

(Adapted from Figure 5, page 22, of "Problems of Underground Gas Storage from the Experience of Consolidated Natural Gas Company," by Finn, Schmidt, and Corrin, presented at Natural Gas Spring Conference, May 11-13, 1944, and published in American Gas Association's pamphlet, "Symposium on Natural Gas Storage.")

At common law in England and in the U. S., one of the rights which the sovereign had was to take the property of a citizen upon the payment of reasonable compensation, when the public need of that property outweighed the individual right of the citizen to do with the property as he pleased. This taking for the public good is called the "right of eminent domain" or otherwise by the rather forbidding name of "condemnation." The right of eminent domain is an extraordinary power and is rarely used. When it is used, it is only as a last resort and where the circumstances which necessitate its use present problems of acquisition which permit of no other solution.

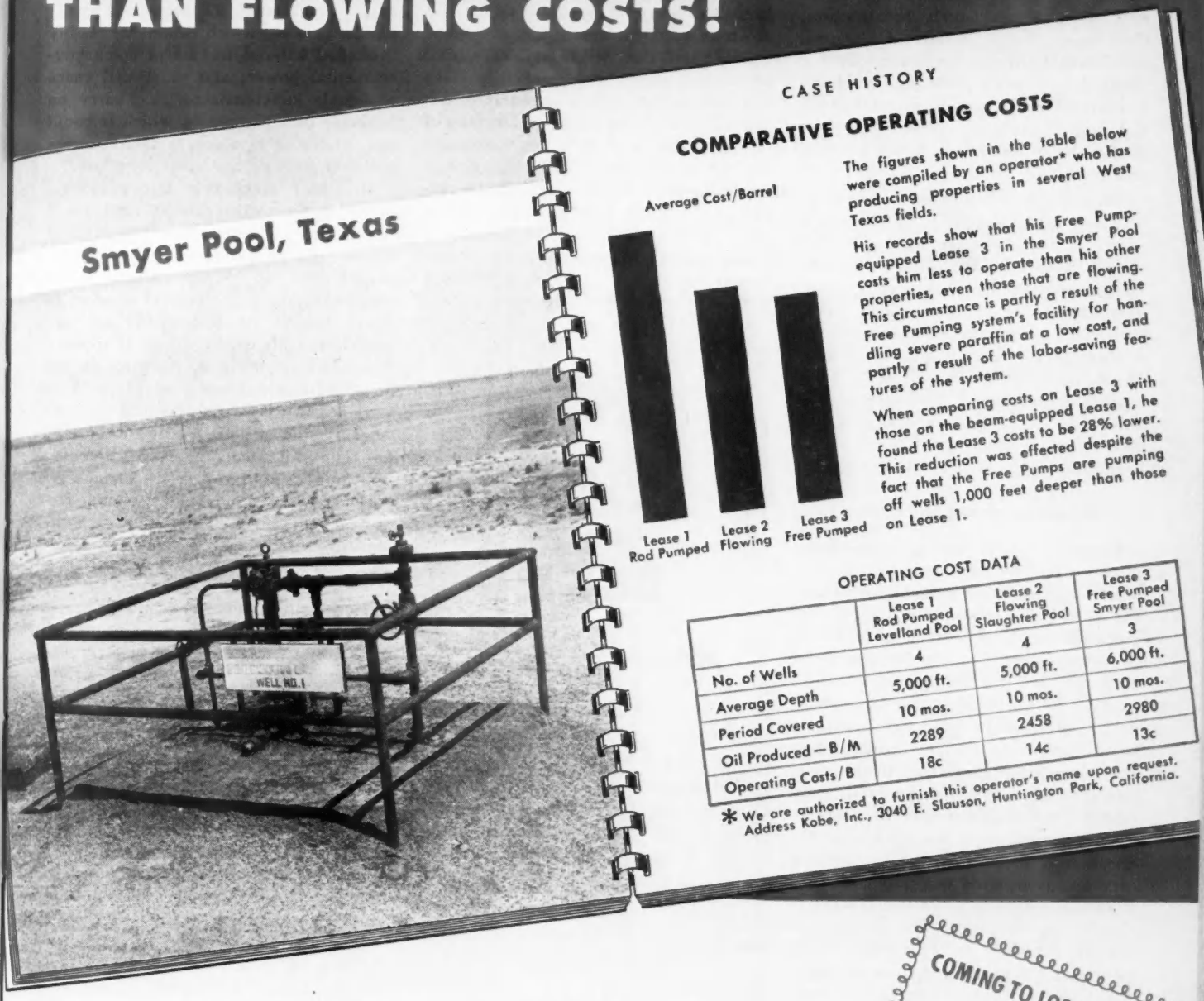
The exercise of this right is not uncommon and has been done for centuries. It is found every day in the taking of land for public highways and bridges, turnpikes, telegraph and telephone lines, irrigation facilities, canals, waterways, wharves, piers and docks, sewers, levees, cemeteries, markets, public parks, airports, public schools and universities, land for state and federal buildings and institutions, and many other uses. The sole reason for the existence of public utilities and common carriers as such is their service to the public under the terms and conditions of that service. One of the rights that a public utility is granted as a public servant is the right of eminent domain. Thus, electric power companies, water companies, and gas distributors have been granted this right. Pipe lines and railroads have been given the right to condemn rights-of-way, space for passenger and freight depots, compressor stations, etc. The statutes which give this right are broad in some instances and narrow in others. Thus, the question arises whether in some states the statutes are such that they may be construed to include the power to condemn depleted underground reservoirs for gas storage purposes, or, the statutes being too narrow, a special legislative act is needed.

State Statutes

An examination of the statutes of the oil- and gas-producing states reveals that a number of states have condemnation statutes which could probably be used in acquiring land for underground gas storage. However, the right of eminent domain emanates only from the statutes and it is often a difficult and complicated task to interpret them since the decisions of the courts of each state will apply in such an interpretation, and the decisions will vary from state to state. Use is also made to one extent or another of the classic rules of construction which the courts of all states recognize. Therefore, a positive statement that the statutes of a given state do or do not permit condemnation is, in the absence of a court ruling, a hazardous undertaking.

It can be said at the outset that except

West Texas Operator* finds *Free Pumping* COSTS ARE LOWER THAN FLOWING COSTS!


Smyer Pool, Texas
WELL NO. 1
CASE HISTORY
COMPARATIVE OPERATING COSTS
Average Cost/Barrel
Lease 1 Rod Pumped
Lease 2 Flowing
Lease 3 Free Pumped
The figures shown in the table below were compiled by an operator* who has producing properties in several West Texas fields.
His records show that his Free Pump-equipped Lease 3 in the Smyer Pool costs him less to operate than his other properties, even those that are flowing. This circumstance is partly a result of the Free Pumping system's facility for handling severe paraffin at a low cost, and partly a result of the labor-saving features of the system.
When comparing costs on Lease 3 with those on the beam-equipped Lease 1, he found the Lease 3 costs to be 28% lower. This reduction was effected despite the fact that the Free Pumps are pumping off wells 1,000 feet deeper than those on Lease 1.
OPERATING COST DATA

	Lease 1 Rod Pumped Levelland Pool	Lease 2 Flowing Slaughter Pool	Lease 3 Free Pumped Smyer Pool
No. of Wells	4	4	3
Average Depth	5,000 ft.	5,000 ft.	6,000 ft.
Period Covered	10 mos.	10 mos.	10 mos.
Oil Produced—B/M	2289	2458	2980
Operating Costs/B	18c	14c	13c

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for West Virginia, Kentucky, and Michigan, which only recently have passed such statutes, no state has a statute which specifically provides for condemnation of depleted underground gas reservoirs for gas storage purposes. The following states do, however, have statutes which the writer believes are broad enough to permit such construction: California, Illinois, Indiana, Oklahoma, and Texas. Other oil- and gas-producing states having such statutes but which are too limited in their scope are Arkansas, Colorado, Louisiana, Mississippi, Nebraska, New Mexico, New York, Ohio, and Wyoming.

The right of an individual to own property and to do with it as he chooses is sacred to the American way of life. It should, therefore, be pointed out and emphasized that land may not be taken in eminent domain proceedings unless authorized by statute and unless and until there have been met a number of legal requirements which constitute a check upon the exercise of this right and an assurance and a safeguard against any appropriation of property which is not permitted by law.

Requirement of a Public Use

One of the requirements above mentioned is that the land must be taken for a public use in order that the exercise of the power of eminent domain may be justified. The necessity and expediency of taking private property for public use under the power of eminent domain is a question for the legislature and the courts do not interfere. In other words, it is up to the people to decide, through their duly elected representatives in the legislature, in what instances the public good requires the condemnation of property upon payment of a fair price. But the question of whether or not the purpose of the appropriation is a public one is a judicial question, i.e., one which must be decided by the courts. The courts have not been wholly in accord, however, as to what is a public use and have struggled with that problem on numerous occasions.

Considering the problem at hand, to enable a gas distributor to condemn underground storage reservoirs for gas storage, it must be shown that such is a public use as distinguished from a private one. It would certainly seem that under the facts as previously described, the use is public. The work of supplying cities with gas has long been held to be a public one for which property may be appropriated under the right of eminent domain and a gas company may lawfully be vested with this power. Since distributors and pipe lines are public utilities rendering a vital service—that of gas supply—to both home and factory, then any facility which is reasonably needed to expedite or make possible adequate service to the public is a public use.

An examination of a few cases which concern eminent domain reveals the attitude of the various courts on this problem. In a California case, the court held that questions regarding use must be determined from the facts of each case. The Louisiana court, in a recent case, has laid down an excellent description of "public use." It said that where service can be more conveniently and beneficially given and the welfare of the community advanced through the taking and owning of property, then such becomes "necessary for the public use" so as to authorize appropriation. The New Hampshire Supreme Court has said that "The phrase refers to the public welfare, not to the active use of the property in some particular manner . . . " The Oklahoma Supreme Court spoke on this exact point in *Delfeld v. City of Tulsa,* when it said: "A public use for which property may be taken by eminent domain includes a use to enable the United States or a state or subdivision thereof to carry on governmental functions and to preserve safety, health, and comfort of the public . . . (a use) to serve the public with some necessity or convenience of life required by the public, as such, which cannot be readily furnished without the aid of some governmental power; and in special cases to enable individuals to . . . carry on business in a manner in which it could not otherwise be done, if their success will indirectly enhance public welfare."

It would seem that this reasoning should apply to the case at hand, for it has a perfect application. The maintenance of an adequate gas supply throughout the winter certainly concerns the safety, health, and comfort of the public. It is a necessity or convenience of life which cannot, it appears, be furnished without the aid of the judicial branch of our government. It is a business whose success will directly enhance the welfare of the public by providing for adequate heat for domestic consumption and indirectly enhance the local economy by enabling plants, factories, offices and stores to operate during extremely cold weather.

Advantages

Local and statewide economy would be further enhanced by year-round gas production and subsequent underground storage. Gas could be sold from old low pressure wells which cannot now be produced because in the winter pipe line pressures exceed the well-head pressures and in the summer when the pipe line pressures are down there is relatively little demand. Small, low-pressure gas fields, presently known to exist but which cannot be profitably produced, could be developed to supply a continuous demand for storage gas. Intermittent production from other wells, which causes premature abandonment because of water encroachment, would be avoided. The community and the state as a whole would benefit from the new market. There would be conservation of gas which might otherwise be lost or never produced. Added supplies would be available for public consumption and added royalties would be paid the landowner.

It might be argued that the use of an underground reservoir would not be a wholly public use, that the gas distributor would derive some private benefit from such an acquisition. But the Supreme Court of Michigan, in a recent case, has said that condemnation proceedings for acquisition of so much and no more property than is necessary for a permissible public use will not be defeated by the mere fact that an incidental

About the Author

BURNS H. ERREBO, born in Pittsburg, Kansas, was graduated in 1944 from the University of Oklahoma with a B.S. degree in petroleum engineering. He served with the Corps of Engineers in the Southwest Pacific. Upon discharge in 1946 he entered the law school at the University of Oklahoma and was graduated with an LL.B. in June, 1949. Errebo has had field experience in gas and oil production as an engineer and roustabout. He is employed presently with Sunray Oil Corporation, Production department, Tulsa. His published articles included: "Unit Operation at Cotton Valley: An Alleged Violation of the Sherman Act," *Tulane Law Review,* October, 1949; and "Condemnation of Depleted Underground Gas Strata for Gas Storage Purposes," *Oklahoma Bar Association Journal,* July 30, 1949. He is a member of the Oklahoma Bar Association.

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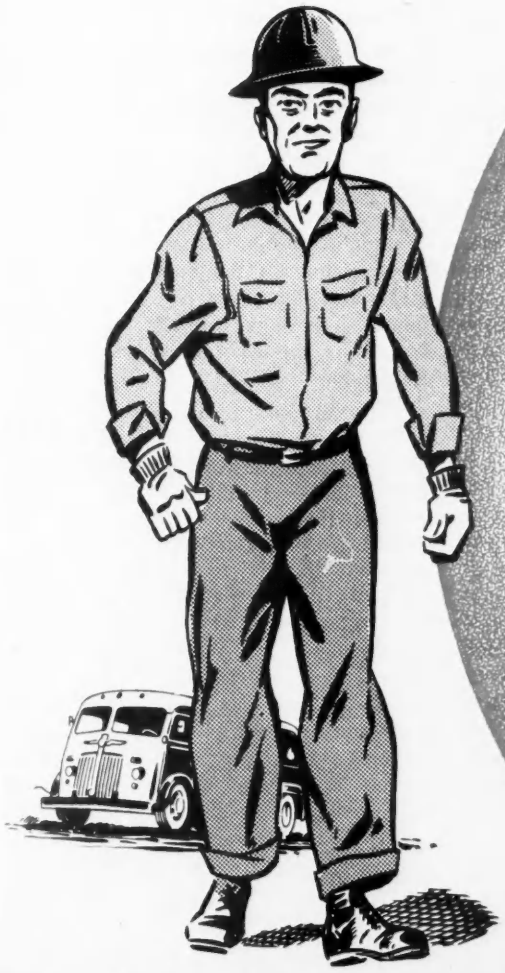

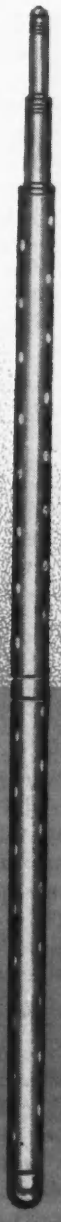

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private benefit or use of some portion of such property will result. Again, the Oklahoma Supreme Court has said that a public use need not be the use of the entire public, but it may be a use for the benefit of a restricted locality, so long as this is in common and not for individuals. This same court has also said that the condemned property does not have to be made accessible to the public in order that the use be a public one. From this language, it is obvious that the fact that a public utility will profit from the sale of the gas will not prevent necessary condemnation.

Statutory Construction

Given a public use, a close look must be taken at the condemnation statutes of the particular state under consideration to determine whether or not condemnation of depleted gas sands for gas storage purposes is authorized. A person might wonder why all the questions and doubts as to what the statute says. It might seem that the statute would either give such a power or fail to give it. But it is not so simple as that. Take the Oklahoma situation. Under its statutes, gas companies are given condemnation rights which may be exercised "in the same manner and by like proceedings as railroad corporations..." And railroad corporations are given the right "to take, hold and appropriate so much real estate as may be necessary for the location, construction and convenient use of its road..." It would appear that this would give a pipe line or distributor of gas the right to condemn underground gas sands "for the convenient" and therefore the necessary, use of its pipe line or gas distribution system.

However, the words of statutes such as those last described must be construed and interpreted strictly and all doubts should be resolved in favor of the landowner, for the power of eminent domain is in derogation of the common right of the owner to hold and do with the land as he pleases.

Yet an eminent domain statute cannot be so narrowly interpreted that its purpose will be defeated. Thus, although the landowner is given the benefit of every doubt, the courts will not allow the purpose of the statute to be defeated by such a strict interpretation that the type of relief which the statute was designed to give is denied. Randolph, a leading writer and authority in the field of eminent domain, in his book entitled "The Law of Eminent Domain," says that a statutory definition of the use should not be taken so literally as to preclude condemnation for a purpose necessarily incidental to the main use. Hence, where several tracts of land are to be condemned for a cemetery, the owner of the one which is not to be used as a place of interment, but as a driveway, cannot assert a want of authority.

A Missouri case has put it: "The necessary incidents of an authority expressly granted need not themselves be expressed... (it is an) old and long established rule that a grant of power to accomplish any particular enterprise and especially one of a public nature, carries with it, so far as the grantor's power extends, an authority to do all that is necessary to accomplish the principal object."

The Oklahoma Court has stated: "To authorize the condemnation of land upon a power delegated by the state, it must appear that the land is necessary to enable it to carry on its business as a public service corporation."

There has been only one case in which condemnation of depleted gas sands has ever been attempted and that was more than 12 years ago. It is a Kansas case, styled *Strain v. Cities Service Gas Company*. The predicament in which the gas company found itself is typical. It was a gas pipe line and service company and furnished gas to numerous public utilities and its petition alleged that because of "sudden and drastic" temperature changes in Kansas during the winter it needed to maintain gas reservoirs to supply gas in increased volumes. It further alleged that it had three such reservoirs already in operation, that it obtained all leases necessary for the use of the depleted sands except the lease belonging to the landowners in the action, and that they refused to lease except at exorbitant prices. The gas company brought condemnation proceedings but was enjoined. The majority was severe in its application of the rule of strict and technical interpretation of eminent domain statutes and held that the Kansas statutes in question were not broad enough.

Minority Opinion

On the other hand, the view of the minority was well put: "It would seem that sites for compressor stations, pipeyards, warehouses, storage reservoirs and expansion chambers, etc., are as necessary for this public utility as sites for depots, workshops and switch yards are to a railroad company... Under the statute, the pipe line company is given the same right of condemnation as railway companies. That which is essential to its operation in the service of the public as a public utility is within the authority of the statute."

This case represents the first decision on the condemnation of depleted gas fields by public utilities in the exercise of their power of eminent domain. The result seems very conservative and contrasts sharply with the realities facing the gas industry today. It is a position that an increasingly fewer number of courts would probably take when faced with the same questions. As a Pennsylvania court said many years ago: "Natural gas is a newly discovered, and as yet unfamiliar product of nature and the law will recognize a general progress in its economical, prudent, and profitable use." It should be kept in mind, however, that this decision is based solely upon a construction of the Kansas statute. The result in any other jurisdiction will therefore depend upon the construction of the applicable statute.

Conclusions and Recommendations

The economic advisability of underground storage in the transmission and distribution of gas is an established fact. Engineers say it is the only feasible way to give the public the service which it demands. The need is pressing. The primary obstacle today to a widespread use of underground storage is the difficulty in acquiring all the acreage overlying a suitable reservoir at a reasonable figure. The legal remedy of eminent domain is the answer. In view of the tremendous expansion of the gas industry and in order to assure an adequate supply of gas to homes and factories in the months in which it is most needed, both producing and consuming states should have a look at their present laws, and use them if they are suitable; if not, then resort should be had to the legislature for the passage of laws similar to those recently passed by the states of West Virginia, Michigan, and Kentucky wherein gas companies are specifically given the right to condemn depleted and exhausted underground strata for gas storage purposes. James B. Sayers was entirely correct when he wrote: "The development of underground storage has created new values in subterranean estates, a value to the user, a value to the owner of the land but an infinitely greater value to the public."

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Surface Minerals Reflect Subsurface Structure in NEW EXPLORATION TECHNIQUE

By BERNARD H. LASKY
Consulting Geologist, Houston

THE term "alteration study" is used in the mining industry to refer to mapping and investigation of clays and other fine mineral aggregates found in the vicinity of mineral or ore deposits.

To the writer's knowledge, the complete mineralogical study of surface sediments, which constitutes the technique of the alteration study in the mining field, has not heretofore been utilized as an exploratory tool in the petroleum industry. Reference has been made, however, to examples of specific mineralization and the relationship of such mineralization to deposits of oil and gas.

Accordingly, as the alteration study is considered as a new concept in the petroleum field, a brief review of some of the basic factors involved in the previous utilization of mineralization as a prospecting tool for oil and gas is presented herein, together with a statement on the comparatively recent application of mineralogical studies to exploration in the mineral industry.

Present exploration problems involve for the most part, secondary or low-relief structural features, areas of complex faulting, stratigraphic traps, and reefs, which are not being entirely resolved by existing techniques. The situation appears to demand a further refinement of today's tools or a new exploration method. Perhaps a combination of both is required.

The approach to the problem is being directed along various lines. An important phase of the program is the research on sedimentation which is being undertaken by the API. For the present, at least, the emphasis in these studies is being placed on environmental factors or influences which would be favorable to accumulation of petroleum rather than on localized structural conditions.

The role of sedimentation, its application to exploration in general and to stratigraphic traps in particular has been indicated by Krumbein,[1] who emphasized the importance of charting or cataloging the mass chemical and the mineralogical properties of the sediments in any consideration of the exploration problem.

STUDIES OF the alteration of minerals in surface sediments are indicative of subsurface structure in an oil and gas exploration technique employing ideas similar to those used recently in mining industry exploration. These mineral studies have been valuable in delineating the subsurface structure of areas on the Texas Gulf Coast and in Louisiana and Mississippi. This work has involved the mapping of both favorable and unfavorable structures, including salt domes and their flanks, high and low relief structures, and other anomalous features, including faulting and stratigraphic traps. The surveys which have been made have indicated that this technique might be employed successfully in other geologic provinces and to problems in exploration which have proved difficult of solution.

This is a condensation of a more detailed paper which was presented before the Houston Geological Society in September.

The mineralogical characteristics of the surface sediments now assume a definite and local, rather than a generalized importance, as it has been discovered by the writer that there is a close relationship between critical minerals contained in the surface beds and the underlying subsurface structure. And as the result of the quantitative studies of the surface mineralogy under strict statistical control, it has been established that alteration of the surface sediments has occurred and that this alteration is related to and is a function of the subsurface. Alteration studies can therefore be utilized as a practical tool to delineate subsurface structure.

In this connection, the word "structure" is used, not to refer to purely localized or so-called "favorable" features alone, but in the broader sense to include general geologic deformation.

Mineralization As An Exploration Tool for Oil and Gas

The role of mineralization as an exploration tool in the oil industry has been recognized by McDermott[2] and by Rosaire.[3]

McDermott reviews the megascopic evidence of oil and gas fields and indicates the potentialities of microscopic determinals in the search for new fields.

Rosaire has indicated that geochemical prospecting, which includes both hydrocarbons and mineralization, takes for its objectives and recognition of the geochemical manifestations of a petroleum accumulation and their interpretation in terms of the origin of the petroleum accumulation itself. Rosaire has presented a

hypothesis which has been postulated to account for the experimental observations of "halo" phenomena.

The objective of previous workers in the field of geochemistry is clearly expressed by Rosaire[3]:

> "As a result of the past successes of geological and geophysical (structural) prospecting, we are now forced to the consideration of exploration for Petroleum enclosed within low-relief structures and stratigraphic traps."

There are marked divergences, therefore, between the work of the writer and that of Rosaire and others, both in concept and in objectives. The writer's studies are based upon the consideration of the general alteration of the surface sediments and are not alone concerned with specific hypogene or secondary mineralization which is the result of the action of ascending subsurface waters and which may or not be present. Furthermore, the objective of the writer is the delineation of the subsurface structure as a problem in structural geology.

Mineralization as an Exploration Tool in the Mining Industry

The study of mineralization has been used effectively in the mining field by the geologist for many years as a means to the discovery of new ore deposits. Secondary mineralization or enrichment has been responsible for the formation of many important ore bodies, and the study of secondary mineralization has led the mining geologist to the discovery of others. The term secondary mineralization is well known and refers specifically to those changes in mineralization which have been associated with the alteration or metamorphism of rocks subsequent to their formation.

Reference should be made to the classic work of Lindgren,[4] which has made great advances in relating minerals and types of mineral deposits to temperature, pressure, and additional geologic elements, and to the more recent work of Newhouse[5] on ore deposits.

Recently, the subject of mineralization as applied to mining exploration has entered a new phase. New mineral deposits were not being discovered at the former rates of discovery, and existing ore deposits were rapidly being depleted.

As a result of this critical situation, research was directed toward the development of a new exploration tool. An important phase of this program has been the study of the alteration of the clays which are often found in association with ore deposits. Today, the alteration study is being used in the investigations of clays and other fine mineral aggregates often found near mineral deposits, as a new and valuable exploration tool.

The technique of the alteration study is one of combined field and laboratory investigations. The field work includes mapping in detail to delineate the alteration zones. This is supplemented by laboratory techniques, which includes microscopic and x-ray examination, chemical analysis, and other standard analytical methods.

Referring to alteration studies, Kerr[6] has stated:

> "The time has not arrived when one may correctly evaluate the implication of alteration studies. To date, the results have more than justified the effort they have entailed . . . it is clear that at least one better illuminated avenue has been found along which to approach the problem of replenishing mineral reserves. The same science of mineralogy which has yielded its scientific lore so generously in the years just past, bids fair to continue to do so."

It should be emphasized that in the

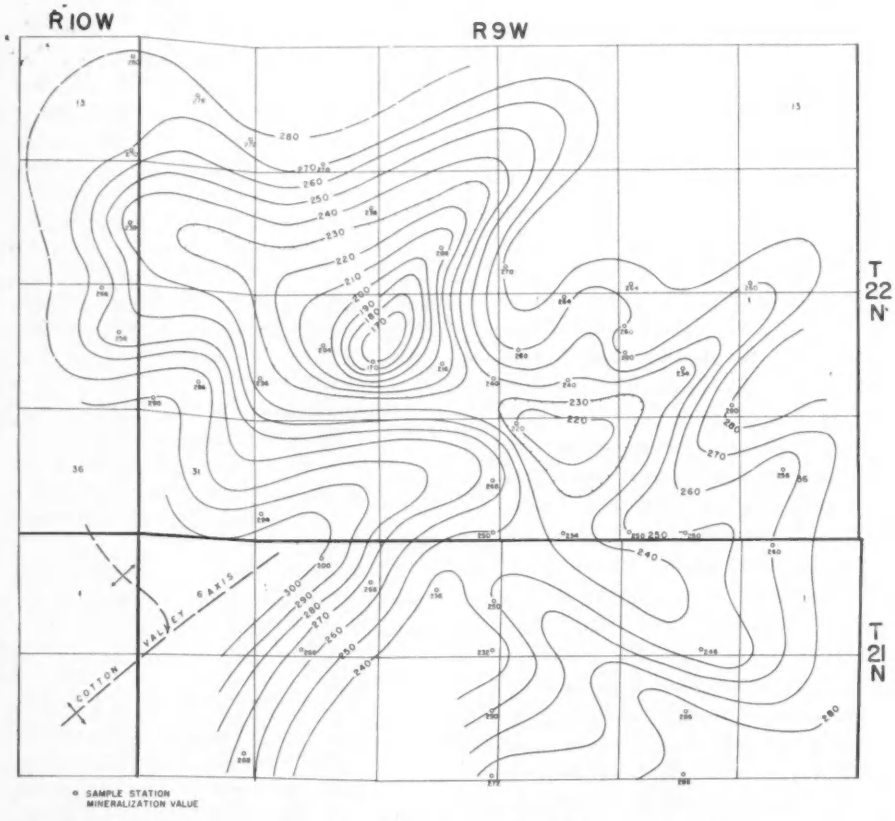

FIGURE 1. A limited amount of profiling in the vicinity of the Nebo field, La Salle Parish, Louisiana, completed in June, 1943. The productive limits of the field are shown as of January, 1946. A substantial amount of development had been completed at the time of the survey, but the field had not been completely drilled up. No subsurface information had been released by the operators at the time of the survey.

About the Author

BERNARD H. LASKY is a graduate of Stanford University with a B.S. in geology and mining. He served as mucker, miner, assayer, surveyor, and mining geologist with mining companies in the West and Southwest. He entered the oil industry as geologist with Empire Gas & Fuel Company in Kansas and Oklahoma. Later, he was geologist with the consulting firm of Hager, Bates & Lewis of Tulsa. During the first World War, Lasky served as private, master engineer, and lieutenant, A.E.F., 316th Engineers, 91st Division, in France and Belgium in 1918-1919. Subsequently, he was partner in the consulting firm, Mowry Bates and Bernard H. Lasky, Tulsa. Following a period as consulting geologist at Tulsa he went to Houston, where he has been a consulting geologist since 1935.

present study, the mineral alteration of the surface beds must be considered from some additional concept other than the secondary process. Mineral anomalies observed in association with Gulf Coast salt domes and possibly with other primary structural features generally are doubtless the result of secondary mineralization. But some additional factor or factors must be involved in the alteration associated with subsurface structures in areas of important geologic unconformities, which undoubtedly present barriers to introduction of secondary minerals into surface sediments.

It is evident that this alteration must be the product of forces which are or have been indigenous to the surface sediments themselves.

Originally, in a preliminary and purely experimental approach to the present study, it was assumed by the writer that mineralization anomalies of some kind or other were associated with many of the major or more important structural features of the Gulf Coast. An attempt was made to map certain of these anomalies and to determine, if possible, the character and the quantities of the mineralization.

It was discovered that mineral anomalies did exist, that they could be measured quantitatively, and that the results of these quantitative determinations indicate there was a striking parallelism between the amounts of critical mineralization and the subsurface structural relief. It was considered that the demonstrable relationship was definite enough to preclude the assumption that the results were haphazard or coincidental.

Examination of additional areas was undertaken. These included areas of both high and low structural relief, of faulting, and in general, localities which were both favorable and unfavorable structurally for the accumulation of oil and gas.

These alteration studies, which were made under strict statistical control in Texas, Louisiana, and Mississippi, indicated that alteration of the surface sediments had occurred in extensive and geologically unrelated provinces, and that the alteration was a function of the subsurface structure in each instance.

Quantitative determinations of the surface alteration could therefore be utilized to delineate the subsurface, and the value of the alteration study as a subsurface mapping tool was indicated.

It is to be emphasized that the technique does not involve the mapping of surface structure, which may or may not be present in any area. The results of the study are represented as an expression of the subsurface relief in terms of the mineralogical alteration of the surface sediments.

Procedure Followed

Samples of the surface sediments are taken at a depth of from 4 to 12 feet. The depth depends upon the conditions of the area but is constant for any area. The samples are taken to the laboratory and are analyzed by generally conventional analytical procedures to determine quantitatively the mineral composition of the sample.

The variations or the differentials in the predetermined critical mineralization of the samples are plotted with respect to the location of the sample stations to obtain graphical representations in the form of contoured maps. These are actually mineralization maps, contoured on quantitative values on an arbitrary datum, but as the relationship between mineralization and the subsurface has been established, a representation of the subsur-

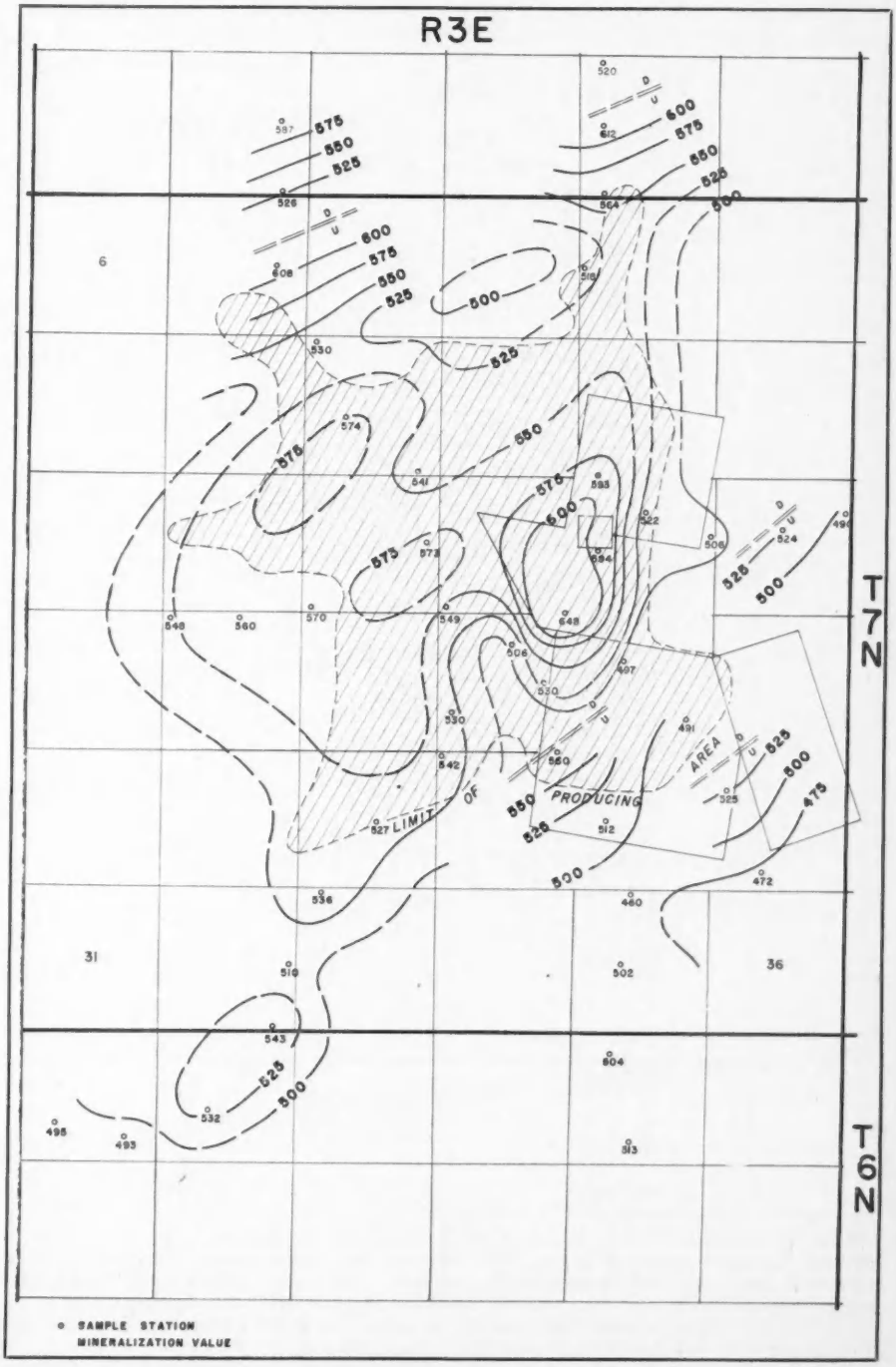

FIGURE 2. Results of a reconnaissance survey of portions of Townships 21 and 22 n, Ranges 9 and 10 w, Webster Parish, Louisiana, which was completed in September, 1944. The survey indicates the synclinal structure between the Cotton Valley field and the Shongaloo field, in Township 21 n, Range 10 w, and Township 23 n, Ranges 9 and 10 w, respectively, and shows the influence of the Homer Dome in Township 21 n, Ranges 7 and 8 w, which is to the east of the area.

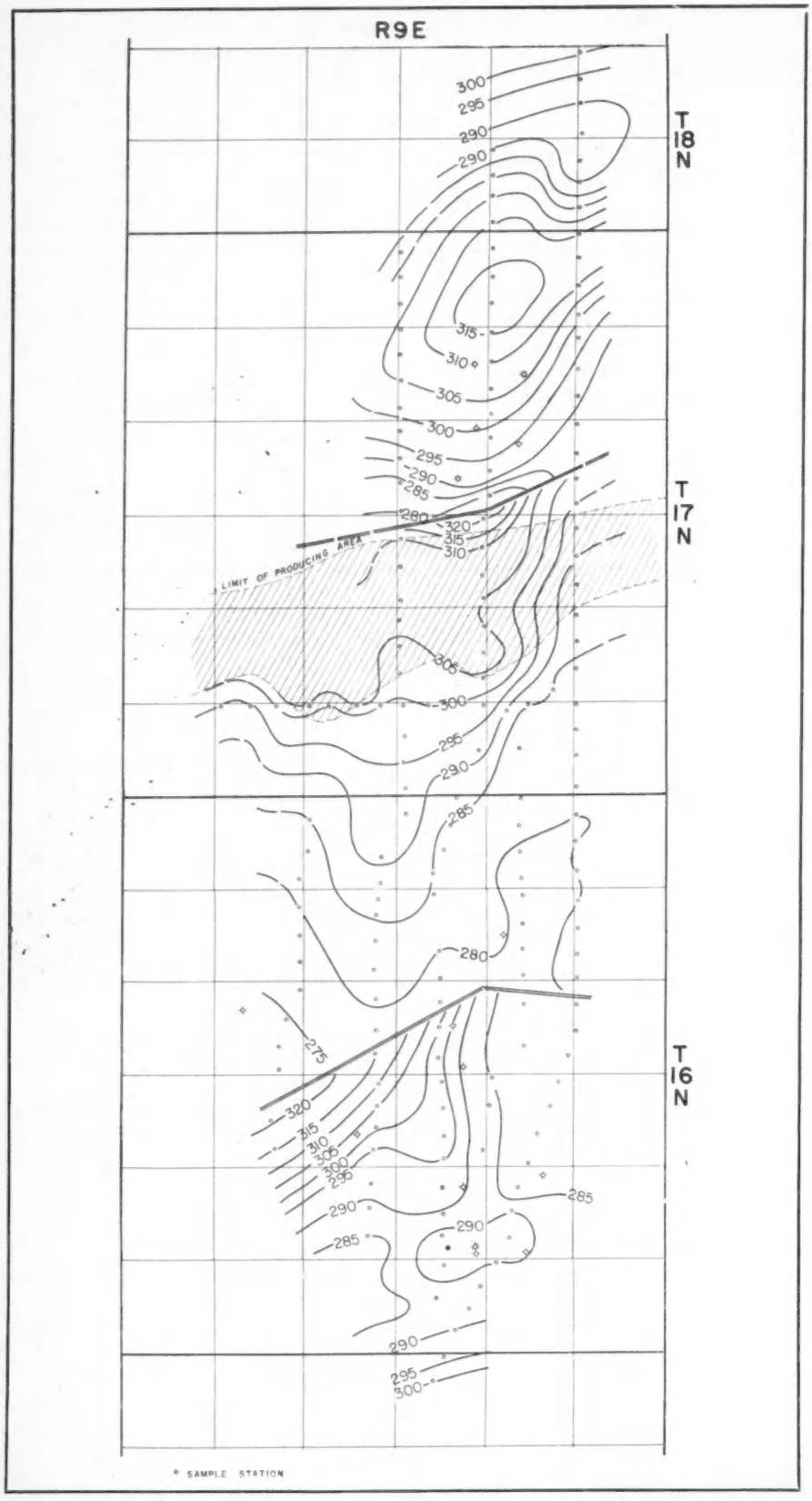

FIGURE 3. Results of a survey of part of the Delhi field and vicinity, in Richland and Franklin parishes, Louisiana, completed in June, 1945. Hatched area represents producing limits of Delhi field as of July, 1946, which was essentially the limits when surveyed. Three favorable anomalies are indicated. A fourth and minor anomaly is shown. The most prominent anomaly is that of the Delhi field. The second is shown approximately two miles north of the productive limit of the field. Two dry gas wells have been completed on this feature subsequent to the date of the survey. The third anomaly is shown four miles south of the productive limits of the Delhi field. Two dry holes have been drilled east of this feature subsequent to the survey. The fourth feature is an unimportant closure south and east of the above, on which two stripper wells had been completed in advance of the survey. North or reverse dip is indicated in the extreme southern limit of the area. This is suggestive of a favorable anomaly to the south. Faulting and stratigraphic traps are indicated by identical changes in mineral alteration. Decision as to fault or pinchout depends upon the area.

face has thus been obtained.

Progressive changes in mineralization have been found to represent unterrupted subsurface dips. Sharp breaks in mineralization are indicative of faulting. The upthrown and downthrown sides of the fault are shown by the different values of the mineralization associated with the faulting.

No correlation between the mineralization and various subsurface depths is possible. It appears, however, that the alteration indicates a composite or cumulative expression of the subsurface, and accordingly, it has been found that the relationship between mineralization and the subsurface exists for those horizons which are the drilling objectives in a given area.

If faulting is present, the surface expression of the fault is indicated, and in such instances the fault and any structure associated with it must be projected to the control depth.

The density of the sample stations will vary with the characteristics of the area and the particular problem involved. Three or four samples to the profile mile are generally satisfactory for detail, although 500-foot stations have been taken where geologic conditions require close spacing. Rapid reconnaissance has succeeded in isolating structural anomalies as a result of running parallel profiles one or two miles apart.

The results of some of the alteration studies which have been made are presented herewith. Certain others which are considered to be important cannot be released on account of the confidential nature of the work involved.

Theoretical Considerations

There are three consecutive stages of progress in development of a given branch of science: (1) collection of data and observation, (2) correlation of information; and (3) development of a theory which genetically relates the data.

To a certain extent, the three stages generally have a tendency to advance simultaneously. Theoretical considerations are, however, secondary to collection of data, correlation of information, and development of an intelligently conceived hypothesis, deduced to resolve the observations and results continuously obtained in the research program.

The entire subject of mineralization, including application to problems of the mining industry in the knowledge of ore-bearing solutions and the various structural features in-

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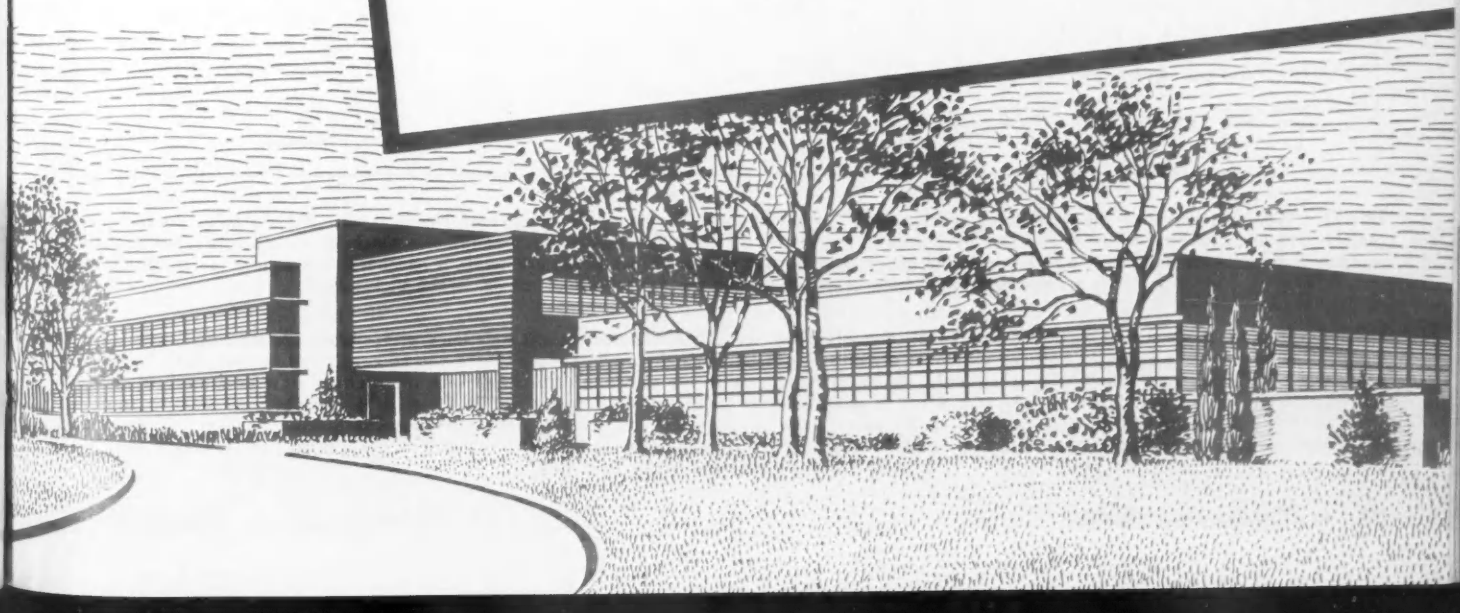

volved, together with recent research in alteration studies in the mineral field and in the petroleum industry, is in first and second stages of advance and to minor degree in the third stage.

However, utilization of observed conditions that have been governed by strict statistical control has been used to pratical advantage in absence of the resolution of a theory for the procedure. On the other hand, what has at the moment been accepted as second theory has been found to be entirely inconsistent and contrary to practical demonstrations that have later followed.

It may be premature to theorize on the relationship between surface mineralization and subsurface structure. There are, however, sufficient data in the literature to provide an interesting approach to an hypothesis.

Attention has been directed to Newhouse and to Lindgren and their work in the mining field and to Krumbein and the research on sedimentation.

Minor[7] in describing the waters of the Gulf Coast region of Texas and Louisiana stated that over shallow salt domes the ground waters either have a higher secondary salinity than the surrounding country or they exhibit a secondary salinity in striking contrast to the primary salinity of the surrounding territory. Minor follows Rogers[8] in suggesting that this feature may furnish an indication of the location of salt domes.

West Texas Analysis

Berger and Fash[9] note that many water samples from wells drilled in the West Texas Salt Basin were analyzed and showed a general relation to geologic structure. They state that variations in the concentration and in the composition of these waters showed a remarkable symmetry to the subsurface structure.

Previous research in geothermics[10] is considered to be important in any consideration of the present subject. It is recognized that surface mineralization in general is directly influenced by the action of ground waters and that it is to a considerable extent the product of temperature and pressure Van Orstrand[11] has indicated that geothermal surveys have shown that relatively high temperatures on the surface are generally associated with favorable structural features, which include anticlines of large and small closure, salt domes, and faults. He also indicated that although radioactivity and thermal conditions are possible sources of temperature variations and although generation of heat by the oxidation of petroleum appears to be of minor importance as a source of heat, the most potent source of heat is to be found in the hot rocks immediately beneath the uplifts.

It is possible that geothermal pros-

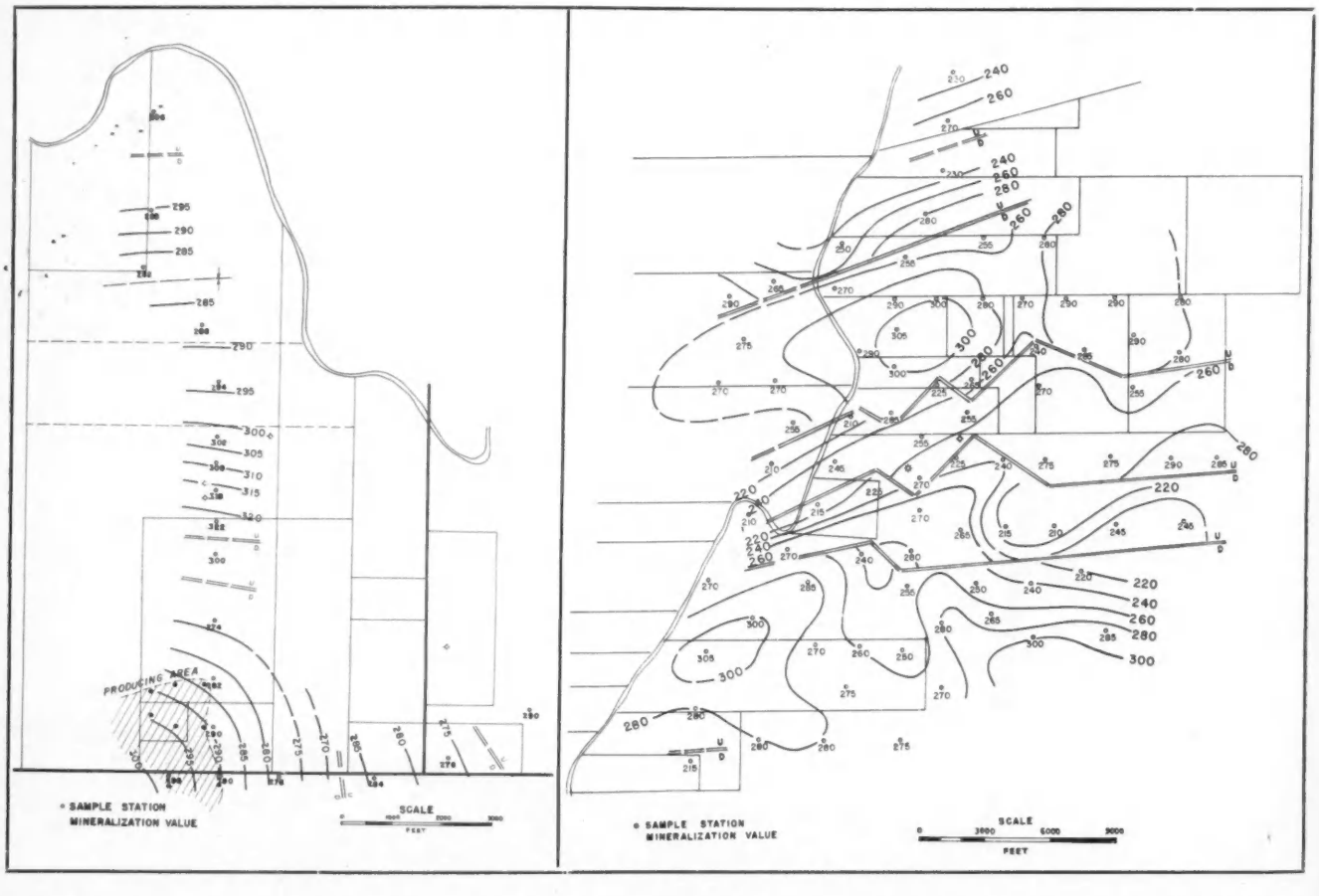

FIGURE 4 (Left). A profile on the north flank of Sugarland Dome, Fort Bend County, Texas, completed March, 1948. The dry holes shown between contours 315 and 320 were drilled to the Vicksburg prior to the survey. There is indicated the probability of a pinchout immediately south of the 320 contour. Subsequent to the survey a test was drilled approximately 1650 feet northeast of the dry holes. It encountered a normal (unfaulted) section, was approximately 600' lower structurally than the dry holes and was dry in the Vicksburg.

FIGURE 5 (Right). A survey in Lavaca County, Texas, completed October, 1948. Two prominent anticlines with closure are indicated, with more or less parallel faulting. Fault blocks between anticlines are structurally low, and the area of these blocks can be considered as synclinal. The surface expression of the faulting is shown, and accordingly, the faults together with the structures associated with the faulting must be projected to depth. As the objective in this area is the Wilcox at a depth of approximately 8000 feet, both domes will be found in the Wilcox from 6000 to 7000 feet south of their positions as indicated on the map. Subsequent to the survey, a test was drilled on the north dome (projected). It was completed as a 48 million cubic foot gas well, in the Yegua formation at 6080-6090 feet, without being drilled to the Wilcox. A northeast offset missed the Yegua sand and was a dry hole in this formation.

pecting would have been developed into an effective and valuable prospecting tool if it were not for the physical and mechanical difficulties involved in its application. These provide a critical handicap to the practical operation of the theory. They include the necessity of drilling core drill holes to depths of approximately 500 feet and of making temperature recordings over a period of several months in order to be certain that accurate rock temperatures are obtained. The high cost of this operation and the time involved in the process make extensive temperature measurements impractical.

If, therefore, measureable differentials in present surface temperatures have been indicated to be associated with and related to subsurface structural conditions, it is not unreasonable to assume, considering the known influence of temperature on mineralization, that temperature may constitute an important and major factor in the alteration which has been observed.

The first and second stages of the study of mineralization and its relation to the subsurface, which consist of collection of data in the field and coordination of this information under strict control, appear to support such a conclusion. The third stage of the investigation, which concerns the development of an hypothesis for the observed data, is undoubtedly for the future.

The explanation of alteration presented above may be an over-simplification, but it is given not as a conclusion but as a concept which appears at the moment to provide a logical basis for a theory with which to genetically relate the field and laboratory demonstrations that have been made.

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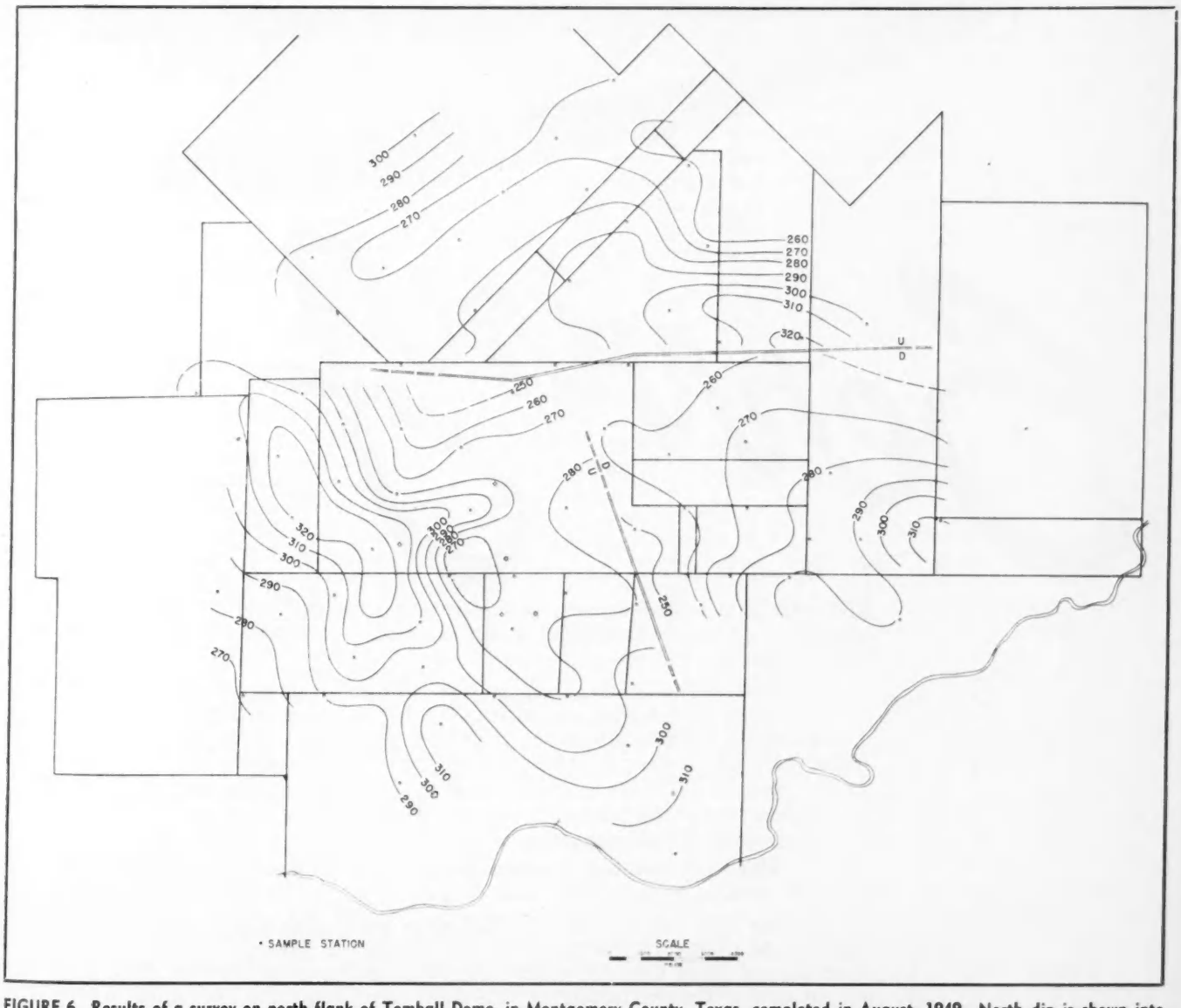

FIGURE 6. Results of a survey on north flank of Tomball Dome, in Montgomery County, Texas, completed in August, 1949. North dip is shown into what is probably the rim syncline in the northern part of the area. The closed dome shown appears to be a part of a northwest-southeast ridge from Tomball Dome. The structure shown is undoubtedly a reflection of the structure of the Wilcox, at approximately 7500 feet. Some shallow development immediately east and south of the closure subsequent to the survey encountered lenticular Yegua sand at approximately 5500 feet in the local syncline and resulted in gas distillate production and dry holes.

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Are OIL SHALES Natural Source Beds of Petroleum?

Part 2—CONCLUSION

By BERNARD J. FERRIS

Exploration Department, Shell Oil Company, Midland, Texas

SOURCE beds have been defined by Trask[1] as "sediments that are or have been capable of generating petroleum." Snider[2] has stated that the most likely source beds are "dark-colored sediments of marine origin, rich in organic matter and located stratigraphically near the rocks in which the oil accumulates." Furthermore, a reducing environment is believed to be a requirement for the formation of source beds, since under oxidizing conditions organic debris is either carbonized or oxidized to carbon dioxide, whereas under reducing conditions such matter may be hydrogenated and converted to petroleum hydrocarbons. Since petroleum consists of compounds deficient in oxygen, the material from which it is derived may also be expected to be low in oxygen content.

Oil shales have been considered by a number of geologists as important natural sources of petroleum. Factors undoubtedly responsible for this belief are:

1. Oil shales generate oil when heated. This process takes place in two stages:
   (a) An initial depolymerization occurs wherein insoluble pyrobitumens are converted to soluble, solid or semisolid bitumens.
   (b) A secondary reaction occurs in which the bitumens are converted to shale oil.
2. Oil shales are rich in organic debris.
3. The mode of origin of oil shales apparently satisfies the requirement of a reducing environment. It is now generally believed that most oil shales were formed in comparatively shallow basins inhabited by aquatic and semi-aquatic organisms. Sedimentation in such basins apparently took place as a simultaneous deposition of organic and inorganic debris. Inasmuch as the reproductive parts of plants are the most resistant to decomposition, they remained partially or completely intact. Other less resistant organic debris was either entirely decomposed, or was partially decomposed to form the homogeneous "kerogen" of the shale. The associated fine-grained inorganic debris undoubtedly excluded much oxygen from the sediment, thereby permitting preservation of the organic matter.

The formation of oil shales has apparently been completed throughout geologic time by a transformation of the original organic material into pyrobitumens.

Effect of Time

Many geologists believe that petroleum has been formed in nature at temperatures far below the conversion points of most oil shales. One writer[3] has stated that petroleum has probably been formed at a temperature somewhere between 65° C. and 200° C. The maximum temperature of 200° C. is suggested by the existence of certain chlorophyll derivatives in petroleum and in some oil shales. These compounds break down at temperatures in excess of 200° C. Furthermore, Cox[4] has stated that most oil basin temperatures have been relatively low throughout geologic time, the maximum probably having been 100° C. for most oil basins.

Inasmuch as strong evidence exists to support the contention that much or all of the world's petroleum was formed at temperatures below that required for the destructive distillation of oil shales, the question arises as to whether geologic time may have been substituted for temperature in the natural conversion of oil shale to oil.

In studying the effects of time on this conversion process, the writer selected a sample of Estonian oil shale and a sample of Green River oil shale from Garfield County, Colorado, ground them to 60-mesh size, and completely extracted them in carbon tetrachloride at 75° C. The shale samples were then placed in thick-walled fire-resistant glass test tubes. The tubes were sealed and put in an electric furnace at a temperature of 200° C. for 4 days. At the end of that time, the tubes were broken; the contents were carefully studied in an effort to determine the presence of free oil, and were then extracted again. The shales were again placed in test tubes which were sealed and subjected to the 200° C. temperature for 3 more days. At the end of this 3-day period, the tubes were again broken, the contents were checked for free oil, and were then re-extracted.

This procedure was repeated on the same samples until they both had been heated for 7 days at each of 4 different temperatures, all below the conversion points of the oil shales. After each heating and preceding each extraction, the shales were microscopically checked for free oil in ordinary light, and were megascopically studied under both low-pressure and high-pressure mercury arc ultraviolet lamps.

The results of the investigations are illustrated in Figures 1 and 2. The curves indicate that for both the Green River and the Estonian shales, the greatest incremental increases in percent soluble extract occurred at 340° C., the highest temperature at which the samples were heated.

The results of these experiments are significant in that they show an apparent transformation to a carbon tetrachloride-soluble material in oil shales heated below conversion temperatures. They indicate, however, that throughout a heating period of 28 days at subconversion temperatures, no free oil was formed.

Although the primary purpose of these investigations was to determine the presence or absence of free oil after heating oil shales at subconversion temperatures,

EXCEPT IN VERY LOCAL AREAS of igneous activity or tectonic disturbance, oil shale, by virtue of its natural destructive distillation, probably has not been a significant source bed of petroleum. This is the second and concluding part of this study of oil shales as possible natural source beds of petroleum. Part 1 was published in the August WORLD OIL.

it is of interest to note that the increase in soluble extract obtained by this heating is in accord with the results of similar work by Maier and Zimmerly[5] and by Rand.[6]

An additional experiment was conducted to determine the effect of prolonged heating of oil shale at relatively low temperatures. In this work, samples of several different oil shales were ground to 60-mesh size, and were completely extracted in carbon tetrachloride at 75° C. They were then placed in test tubes which were sealed and immersed in a water bath which maintained a constant temperature of 80° C. After 26 days, the tubes were removed from the bath, and their contents were checked for free oil and were then extracted. Table 1 records the results of this test.

As may be seen from the table, out of the 6 "kerogen"-bearing sediments tested, only 2 showed an increase in soluble extract after being heated at a relatively low temperature for nearly a month. Of these 2, the tasmanite gained only 0.07 percent, which is undoubtedly within the limits of experimental error. A fairly significant increase in the soluble extract of the Green River oil shale was noted, however. In all cases, observation of the samples in ordinary and ultraviolet light did not indicate the existence of any free oil.

Effect of Catalysis

The presence of petroleum of small quantities of such elements as nickel, vanadium, tin, copper, lead, iron, silver, uranium, and many others has led to the belief that these metals may have had a catalytic effect in the formation of petroleum.

In addition to the possible inorganic catalysts, bacteriological research has suggested that the enzymes and metabolic products of bacteria and other organisms may have a biocatalytic effect on the transformation of primary organic matter.

Although catalysts have been used extensively in petroleum refining processes, a relatively small amount of experimental work has been done on the possible influence of catalysts on the natural conversion of source matter to petroleum.

In his research on the generation of oil in rocks by shearing, Hawley[7] experimented on the effect of catalysts on the quantity of extract obtained from oil shales. He treated oil shale samples with various catalysts either preceding or during extraction. His work showed that compounds such as sulfuric acid, hydrochloric acid, sodium hydroxide, and sodium chloride had little effect on the quantity of soluble extract from oil shales. Where glacial acetic acid and anhydrous aluminum chloride were mixed with the oil shales, appreciable increases in the solubility of the organic matter were noted. It is possible that the acetic acid reacted with some of the insoluble calcium or magnesium fatty acids in the oil shale, thereby making them soluble. If the acetic acid did react, it obviously did not perform as a catalyst.

In tests where oil shale was mixed with a highly adsorptive fuller's earth and then extracted, a notable decrease in the solubility of the organic matter occurred. This decrease suggested to Hawley that the fuller's earth adsorbed some of the soluble components of the oil shale, and consequently caused them to resist solution.

In later work, Hawley[8] mixed Colorado oil shales with fuller's earth, potassium hydroxide, and sodium chloride solutions and subjected them to high shearing pressures; the solubility of the organic matter was not increased. When anhydrous aluminum chloride was mixed with oil shale and sheared, a small increase in soluble extract occurred.

To determine the effect of several different possible catalysts on the conversion of oil shales at relatively low temperatures, the writer prepared fine powders of silver, iron, copper, nickel, zinc, aluminum, and barium chloride. These substances were individually mixed with powdered samples from the same hand specimen of Green River oil shale, and were placed in test tubes which were subsequently sealed.

The samples mixed with silver, iron, copper, and barium chloride were heated for 8 days in a constant-temperature water bath at 80° C. Those mixed with nickel, zinc, and aluminum were heated for only 2 days at the same temperature. Additional samples of the same oil shale were mixed individually with barium chloride and nickel, and were heated in sealed tubes in an electric furnace for 30 hours at a temperature of 260° C.

In all cases, samples of the same oil shale were heated without possible catalysts at identical temperatures and for the same lengths of time to provide a basis for comparison.

In most of the tests, the percent of soluble extract obtained by heating oil shale mixed with the possible catalysts varied only slightly from the percent of soluble extract obtained from the oil shale which was heated alone. However, relatively large percentages of soluble extract were obtained where barium chloride and copper were mixed (individually) with the oil shale. It is possible that these larger amounts of extract may be a result of the greater length of time that the oil shale was heated (8 days). However, other samples of the same shale which were mixed with silver and iron, and which were also heated for 8 days, showed no appreciable increase in solubility. It is obvious that these tests should be repeated several times before any final, positive conclusions may be drawn as to the catalytic effect, if any, of barium chloride and copper in the transformation of the pyrobitumen of oil shale to a carbon tetrachloride-soluble material at subconversion temperatures.

As in the preceding experiments, careful checks were made to determine the existence of free oil after heating the oil shales in the presence of possible catalysts. In all cases, no free oil was formed.

Effect of Radioactivity

Small quantities of radioactive substances are common in many sediments. The elements responsible for most of the radioactivity in sediments are uranium, thorium, and potassium. The disintegration of such elements liberates alpha particles (high-velocity helium nuclei), and beta particles (high-velocity electrons). Nearly 90 percent of the energy emitted in radioactive decay is converted to the kinetic energy of alpha particles.[9]

It is believed that the major portion of radioactive elements in sediments has been secondarily introduced from the disintegration of igneous rocks. It is known, however, that some marine organisms are capable of the primary concentration of radium.

Laboratory experiments have been conducted to determine the effects of radioactivity on organic debris. These investigations have shown that fatty acids isolated from ocean-bottom muds may be converted into paraffin hydrocarbons by alpha particle bombardment in a cyclotron. The effectiveness of radioactive conversion is apparently a func-

TABLE 1

SAMPLE	Percent Soluble Extract of Unheated Oil Shale	Percent Additional Soluble Extract After Being Heated at 80° C. for 26 Days	Cumulative Percent Soluble Extract	REMARKS
Estonian Oil Shale	0.15	0.00	0.15	No free oil
Tasmanite	1.49	.07	1.56	No free oil
Scottish Torbanite	.42	.00	.42	No free oil
Sao Paulo, Brazil Oil Shale	.51	.00	.51	No free oil
Kentucky Oil Shale	.44	.00	.44	No free oil
Green River Oil Shale	3.32	.41	3.73	No free oil

tion of the accessibility of alpha particles to the organic matter. This, in turn, is a direct function of the intimacy of the mixture of the sediment and the radioactive material, and in inverse function of particle size.[19]

It has been known for some time that marine black shales (which are commonly rich in organic debris) are high in radioactivity. Coal, however, is relatively non-radioactive. It is concluded, therefore, that radioactivity in sediments is a function of the type, rather than of the quantity, of organic debris present.

More than 20 years ago, it was suggested that oil might have been generated in nature by the radioactive polymerization of methane. Subsequent study has indicated, however, that radioactivity has probably been more effective in the transformation of solid or liquid organic matter in the source bed.

Consideration of the foregoing statements suggests the possibility that radioactive energy may have taken the place of heat energy in the natural conversion of oil shale to petroleum.

To investigate this possibility, 2 powdered samples of Green River oil shale from the same hand specimen were thoroughly mixed and heated in sealed test tubes at 265° C. for 1 week. One of the tubes contained 4 grams of oil shale; the other contained 4 grams of oil shale and 1 gram of finely divided, pure carnotite (a uranium-bearing mineral).

After the heating, a careful examination of the samples showed that no free oil had been formed. The contents of each tube were subsequently extracted in carbon tetrachloride under identical conditions of pressure, temperature, and time. There was no appreciable difference in the amount of extract obtained from the 2 samples.

Summary and Conclusions

It is the opinion of many geologists that most of the earth's oil was formed at temperatures well below the conversion temperatures of oil shales. Facts which support this contention are:

1. Certain chlorophyll derivatives exist in petroleum and in some oil shales. These substances undergo chemical alteration at temperatures exceeding 200° C.
2. Bottom hole temperatures in oil wells are considerably less than oil shale conversion temperatures.
3. Estimates of the temperatures in oil-producing sediments by use of the geothermal gradient do not approach the temperatures at which oil shales are destructively distilled.

The suggestion has been made that geologic time may have been substituted for temperature in the natural conversion of oil shale to oil. However, the experiments described in this paper demonstated that:

1. No free oil was formed when Estonian and Green River oil shales were heated for a total of 28 days at temperatures ranging from 200° C. to 340° C. (subconversion temperatures).
2. No free oil was formed when 6 kerogen-bearing sediments of different geological ages and from diverse goegraphical locations were heated for 26 days at 80° C.

To investigate the possibility that catalysis or radioactivity may have caused the conversion of oil shale to oil in nature, experiments were conducted in which oil shales were heated at subconversion temperatures with various possible catalysts and with a radioactive substance. These tests showed that:

1. No free oil was formed when samples of Green River oil shale mixed with various possible catalysts were heated at 80° C. for either 2 or 8 days; no free oil was formed when similar samples mixed with possible catalysts were heated at 260° C. for 30 hours.
2. No free oil was formed when a sample of Green River oil shale mixed with carnotite was heated for 1 week at 265° C.

It has been postulated that pressures existing at great depths may effect the conversion of oil shale to oil. However,

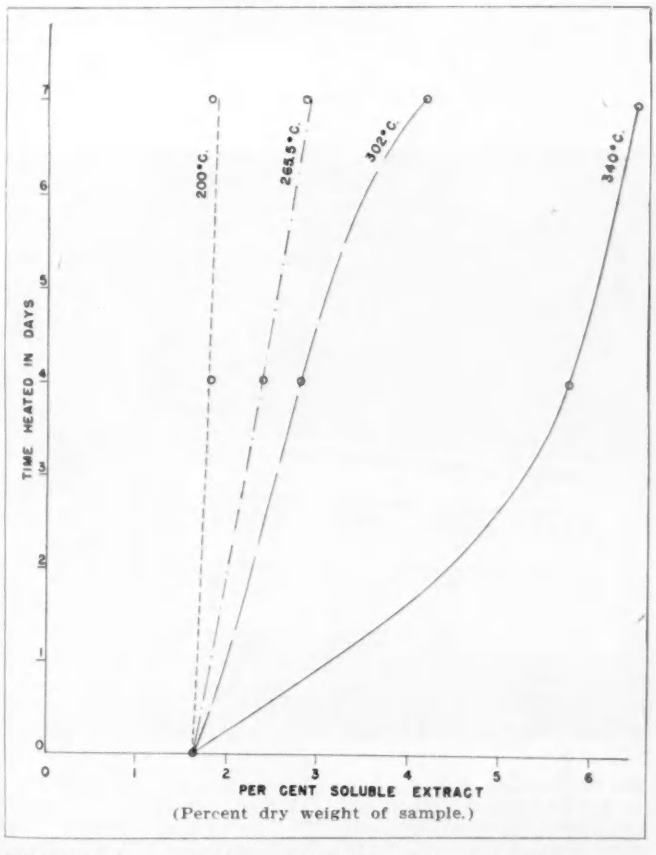

FIGURE 1. Curves showing relation between formation of a carbon tetrachloride-soluble material in Green River oil shale and time and temperature.

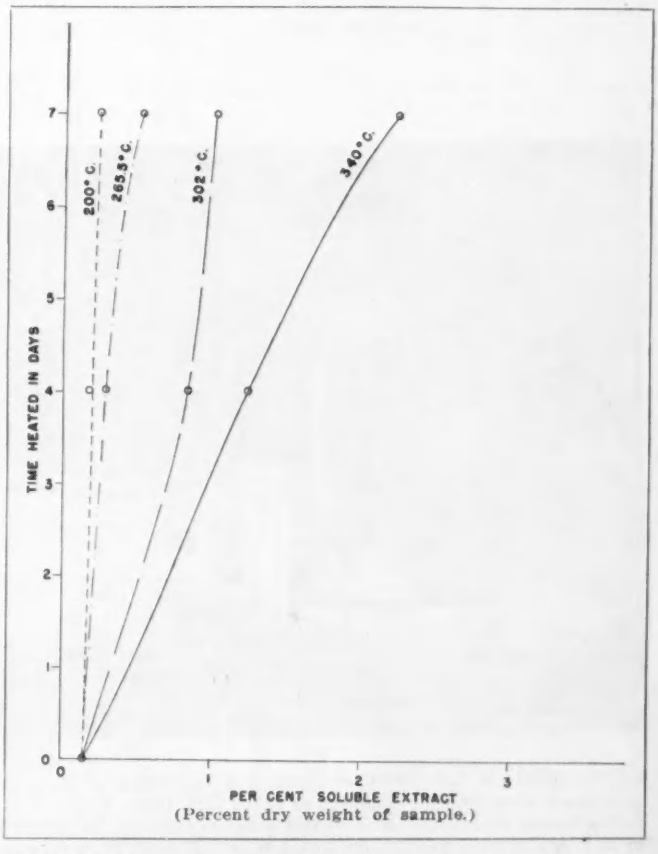

FIGURE 2. Curves showing relation between formation of a carbon tetrachloride-soluble material in Estonian oil shale and time and temperature.

in experiments conducted by Van Tuyl and others:

1. Pressures ranging from 5102 to 30,612 pounds per square inch, when applied to oil shales for a total time of 1 hour at a temperature of 100° C., did not produce free oil.[11]
2. Pressures up to 200,000 psi applied to an Estonian oil shale for 68 days and a pressure of 250,000 psi applied to a Colorado oil shale for 20 days produced no free oil.[11]

Additional facts which dispute the theory that oil shale has been a natural source bed for large quantities of oil are:

1. Free oil is not associated with oil shale, except possibly in rare instances where oil shale deposits have undergone intense heat from igneous activity or from tectonic movement.
2. In general, oil fields are not associated with oil shale deposits.
3. The great age of many oil shales not associated with petroleum is a strong indication of the chemical stability of kerogen. It would seem that if most petroleum were formed by the thermal conversion of kerogen, geologically ancient oil shales such as those occurring in the Cambrian Albert series should have been transformed to petroleum long before the present era.
4. According to Brooks,[12] the genesis of petroleum by the thermal decomposition of kerogen might be expected to leave a carbonized, possibly graphitic residue. However, he states that " . . . disseminated graphitic material is geologically far removed and geographically usually very remote from oil-producing strata."
5. Leslie,[14] in expressing an application of Le Chatelier's Principle, states that the effect of pressure is to "favor the reactions resulting in the combination of several molecules into fewer molecules." Since oil shales depolymerize when they are destructively distilled, it would therefore seem that the thermal decomposition of oil shales should not take place under such pressures as exist deep within the earth's crust.

It is readily admitted that the number and complexity of variable factors which exist in nature cannot be accurately duplicated in the laboratory. We cannot even approach experimentally such quantities as geologic time, or the effects of the radioactive process throughout millions of years. Consequently, the results of any laboratory work on the problem of petroleum source beds must be discounted to some extent.

Nevertheless, on the strength of the existing evidence (summarized in the preceding statements), it is concluded that, except in local areas of igneous activity or tectonic disturbance, oil shale, by virtue of its natural destructive distillation, has not been a significant source bed of petroleum.

Labels for the horizontal axes of the five curves in Part 1 of this article (August WORLD OIL, pages 80-88) were erroneously omitted. All should have been labeled: SOLUBLE EXTRACT PERCENT DRY WEIGHT OF SAMPLE.

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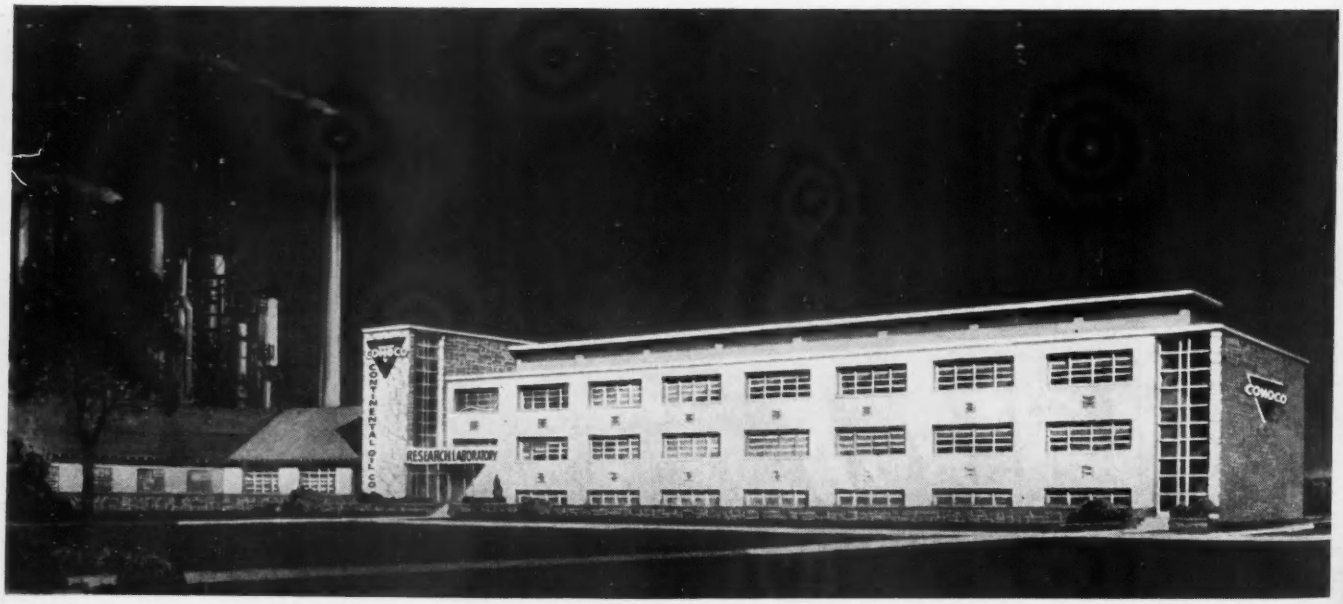

Continental Oil Company inaugurated a celebration of its 75th anniversary when ground was broken at Ponca City, Okla., for the $2¼ million research laboratory shown in this architect's drawing. A message by L. F. McCollum, president, was heard by several thousand in attendance and was carried by telephone to gatherings of Continental employes at 36 points. Dr. James Rhyne Killian, Jr., president of Massachusetts Institute of Technology, Cambridge, Mass., was principal speaker. About half the building will be occupied by the laboratory section of the Production Research division, while the other half will be occupied by the Central Research laboratories. The new building will be a three-story structure containing six individual laboratory units and almost 40,000 square feet of floor space. The building will be of reinforced concrete construction with masonry exterior and stone trim. Wigton-Abbott Corporation, Plainfield, N. J., is engineer and contractor.

New WHELAND TABLE TOP ROTARY

Model A-17—17½" Through Table · Model A-20—20½" Through Table

FACTORY "RUN-IN"

RUGGED

QUIET

PRECISION BUIL

EASY TO MAINTA

HIGH SPEED, OIL BATH ROTARY WITH RAISED GUARD FOR SAFETY

NEW FEATURE

A recent modification on the New Wheland Table Top Rotary now provides eight sturdy built-in holds, one on each corner, to make this one of the world's easiest rotaries to pick up and move.

CUTS RIGGING UP TIME

BASE: Fabricated steel plate with cast steel center. Derrick floor easily fitted to box shape. Pipe can be stacked on top surface. Safe! Steel guard raised 1¾" above revolving table.

TABLE: Steel casting rotates on precision ball bearings in hardened and ground races that take both radial and thrust loads.

BRONZE TABLE BUSHING: Alemite lubricated. Prevents scoring of table.

GEAR AND PINION: Gleason spiral gear and pinion, standard equipment. Gears are shock resistant and perfectly lubricated to run smoothly, quietly.

PINION SHAFT ASSEMBLY: Removable as a unit for easy maintenance. Shaft is forged steel, precision machined, mounted on Timken bearings. Pinion locked at factory in perfect alignment with main gear for long trouble-free operation.

INBOARD AND OUTBOARD PINION SHAFT SEALS: In addition to new, improved mechanical seal, a positive type rubbing seal excludes all grit, sand, etc., from outboard bearing.

SUPERIOR LUBRICATION: Proper grade lubricant for each part assured by three separate, securely sealed oil compartments. Fill and check from top. Three separate oil pipes with bell reducers make it easy to add oil, separate automobile type dip sticks for checking oil level.

LOCKING DEVICE: Locking device is simple, positive. Engages ring gear, eliminates shock from pinion, shaft and bearing. Lock handle on top of table, convenient to driller.

SPLIT MASTER BUSHING: Cast steel. Takes A.P.I. Standard drive bushings. Master bushing alone or both master and drive bushings can be locked to table.

FULL MECHANICAL DETAILS ON REQUEST

WHELAND

THE WHELAND COMPANY, CHATTANOOGA, TENN., U. S. A.

ROTARY DRILLING MACHINERY

DOMESTIC DISTRIBUTORS

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Tulsa, Oklahoma
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Exploration

Up 11.9 Percent Over 1949

THE search for new sources of oil and gas continued very active during August and boosted the year's completed wells total to a 11.9 percent lead over last year's record-breaking exploratory drilling activity. However, the month's wells numbered slightly less than those completed in July, which set an all-time high.

Although drilling rates have been stepped up in the past several months, the results have not quite kept pace. Only 17.7 percent of the August tests found production, and that was the second straight month that producer-to-dry hole ratios failed to measure up to previous averages. July's score had been only 17.8 percent, but in June 24 percent of all tests proved to be commercial producers. Over-all success averages usually are close to 20 percent.

So far this year, 19.6 percent of all exploratory wells have found the pay, but a year ago at the same time the score was 21.1 percent. July and August's declines resulted in this year's drilling success dropping behind that of 1949.

The month's new fields and new pay horizons numbered 111 against 113 found in record-breaking July, and extensions to proven fields totaled 24 to last month's 29. Dry holes drilled in August totaled 627 while 654 exploratory failures were drilled a month earlier.

(See Tables on Pages 94-96.)

Summary of Results of Exploratory Drilling

ITEM	Aug., 1950	July, 1950	EIGHT MONTHS Jan.-Aug. 1950	1949	Percent Diff.
Oil Discoveries	90	98	712	673	+ 5.8
New Fields	66	78	523	466	+ 12.2
New Pays	24	20	189	207	— 8.7
Distillate Discoveries	5	9	55	96	— 42.7
New Fields	4	5	44	51	— 13.7
New Pays	1	4	11	45	— 75.6
Gas Discoveries	16	6	94	93	+ 1.1
New Fields	12	5	82	75	+ 9.3
New Pays	4	1	12	18	— 33.3
Total Discoveries	111	113	861	862	— 0.1
Extensions to Fields	24	29	218	173	+ 26.0
Oil Fields	21	23	193	156	+ 23.7
Distillate Fields		3	7	11	— 36.4
Gas Fields	3	3	18	6	+200.0
Total Prod. Tests	135	142	1,079	1,035	+ 4.3
Dry Holes	627	654	4,419	3,878	+ 14.0
Wildcats	607	639	4,266	3,824	+ 11.6
New Pays			6	7	— 14.3
Outposts	20	15	147	47	+212.8
Total Expl'tory Tests	762	796	5,498	4,913	+ 11.9
Percent Productive	17.7	17.8	19.6	21.1	
Percent Dry	82.3	82.2	80.4	78.9	

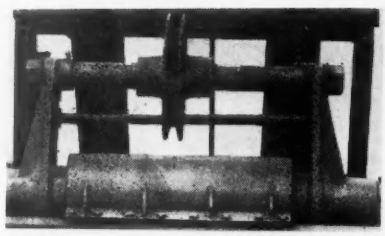
Results of Exploratory Drilling in August and First Eight Months, 1950-1949, by Districts

State or District	MONTH OF AUGUST, 1950													FIRST EIGHT MONTHS, 1950																
	Productive Tests									Total Productive	Unproductive Tests			Total Exploratory Tests	Productive Tests									Unproductive Tests				Total Exploratory Tests	
	New Fields			New Pays			Extensions								New Fields			New Pays			Extensions			Total Productive				Total Dry			
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas		Wildcats	New Pays	Outposts		Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas	8 Mo. 1950	8 Mo. 1949	Wildcats	New Pays	Outposts	8 Mo. 1950	8 Mo. 1949	8 Mo. 1950	8 Mo. 1949
Alabama											1			1	1		1							2		13			13	10	15	10
Arizona											1			1												4			4	4	4	4
Arkansas	1									1	10			11	6	1		1			1			9	12	62		2	64	52	73	64
California	2								1	3	35		3	41	14		1	5		1	13		2	36	31	238	3	13	254	233	290	264
Colorado	2									2	5			7	3									3	1	29		1	30	29	33	30
Florida											1			1												7			7	10	7	10
Georgia																										4			4	4	4	4
Idaho																										3			3		3	
Illinois	2			2			7			11	71			82	15			13			47		1	76	72	470			470	373	546	445
Indiana	5			2						7	23			30	27			6			3			36	39	289		8	297	258	333	297
Kansas	9			1			1			11	56			67	68		4	1			1			74	68	390			390	256	464	324
Kentucky	3						1			4	16			20	8		1	1			2			12	11	56			56	30	68	41
Louisiana	2			3	1	1				7	17			24	17	8	2	14	8	3	8	2	1	63	79	135	1		136	157	199	236
North Louisiana	1			1	1					3	8			11	3	1		2	4	3	5		1	19	19	60	1		61	86	80	105
South Louisiana	1			2		1				4	9			13	14	7	2	12	4		3	2		44	60	75			75	71	119	131
Maryland																										1			1		1	
Michigan	3						1			4	27			31	19		4	1			2			26	19	184			184	196	210	215
Mississippi											9			9	8	2		1				2		13	6	95		3	98	79	111	85
Missouri																										3			3	5	3	5
Montana											9			9							2		1	3	6	37			37	22	40	28
Nebraska						1				1	5			6	3		1				2		1	7	1	32			32	4	39	5
New Mexico											10		2	12	9			4			7			20	15	49		6	55	35	75	50
Ohio											1			1							1		2	3	3	7			7	25	10	28
Oklahoma	5		2	2			4		1	14	41			55	52	1	6	22	1		28	1	2	113	83	325			325	301	438	384
Pennsylvania																									2				1		3
South Dakota											2			2												4			4	2	4	2
Tennessee																									1	4			4	13	4	14
Texas	29	4	10	13		3	6		1	66	252		13	331	264	32	62	114	2	8	73	2	8	565	553	1754	1	107	1862	1684	2427	2237
Dist. 1 S. Central	1	1								2	19			21	9	2	1			1				13	15	130		2	132	160	145	175
Dist. 2 Middle Gulf	2		2	1		2				7	22		3	32	9	4	12	10	1	3			3	42	50	98		10	108	113	150	163
Dist. 3 Upper Gulf	1	2	1	8					1	13	23			36	12	10	4	30	1	2	7	2	4	72	87	140		12	152	166	224	253
Dist. 4 L. Gulf-S.W.	2	1	2	2		1				8	30			38	16	6	18	27		2				69	84	198		3	201	240	270	324
Dist. 5 E. Central											10			10	2		1				1			4	4	50			50	50	54	54
Dist. 6 Northeast											6			6	5	4		2			2		1	14	16	49	1	5	55	49	69	65
Dist. 7-B N. Central	11		3				1			15	52		1	68	96	3	12	9			6			126	117	393		17	410	382	536	499
Dist. 7-C W. Cent.	1		2	1			1			5	21		2	28	15	2	4	7			6			34	27	123		12	135	68	169	95
Dist. 8 West	4						2			6	23			29	40			21			31			92	59	178		14	192	128	284	187
Dist. 9 North	7			1			2			10	46		7	63	59	1	10	8			20			98	93	388		32	420	324	518	417
Dist. 10 Panhandle															1									1	1	7			7	4	8	5
Utah											4			4				1						1	3	9			9	12	10	15
Washington																1								1	1	1			1		2	
West Virginia																									6				2		8
Wyoming	3			1						4	11		2	17	8			5			3			16	24	61	1	7	69	81	85	105
Total U.S.	66	4	12	24	1	4	21		3	135	607		20	762	523	44	82	189	11	12	193	7	18	1079	1035	4266	6	147	4419	3878	5498	4913

Walker-Neer C-34 Spudder, owned by Gulf Oil Corp., drilling at 5,000 ft., near Odessa, Texas

More Snap . . . No Jolt

The C-34 Adds a New, Outstanding Feature . . . Walker-Neer's Exclusive "Tor-Shock" Shock Absorber



Now standard on the C-34, as on other Walker-Neer Spudders, is Walker-Neer's recent, major development, the "Tor-Shock" (rubber torsion) shock absorber, which is built into the spudding beams (see picture at left). All solid jar, so destructive to equipment, is eliminated . . . the tools are given extra snap . . . and you get a remarkably smooth, quiet operation.

Available on skid or tandem mount, the Walker-Neer C-34 is capable of handling any job which any 5,000-foot servicing unit, top-to-bottom spudder, or clean-out machine can handle. Each drive has independent clutch, with controls located in one operator's position. All high-precision, high-alloy roller chain design; V-belt drive from engine to clutch shaft.

Write for 8-page booklet giving full details

WALKER-NEER MACHINE COMPANY

P. O. BOX 2490 **Wichita Falls, Texas**

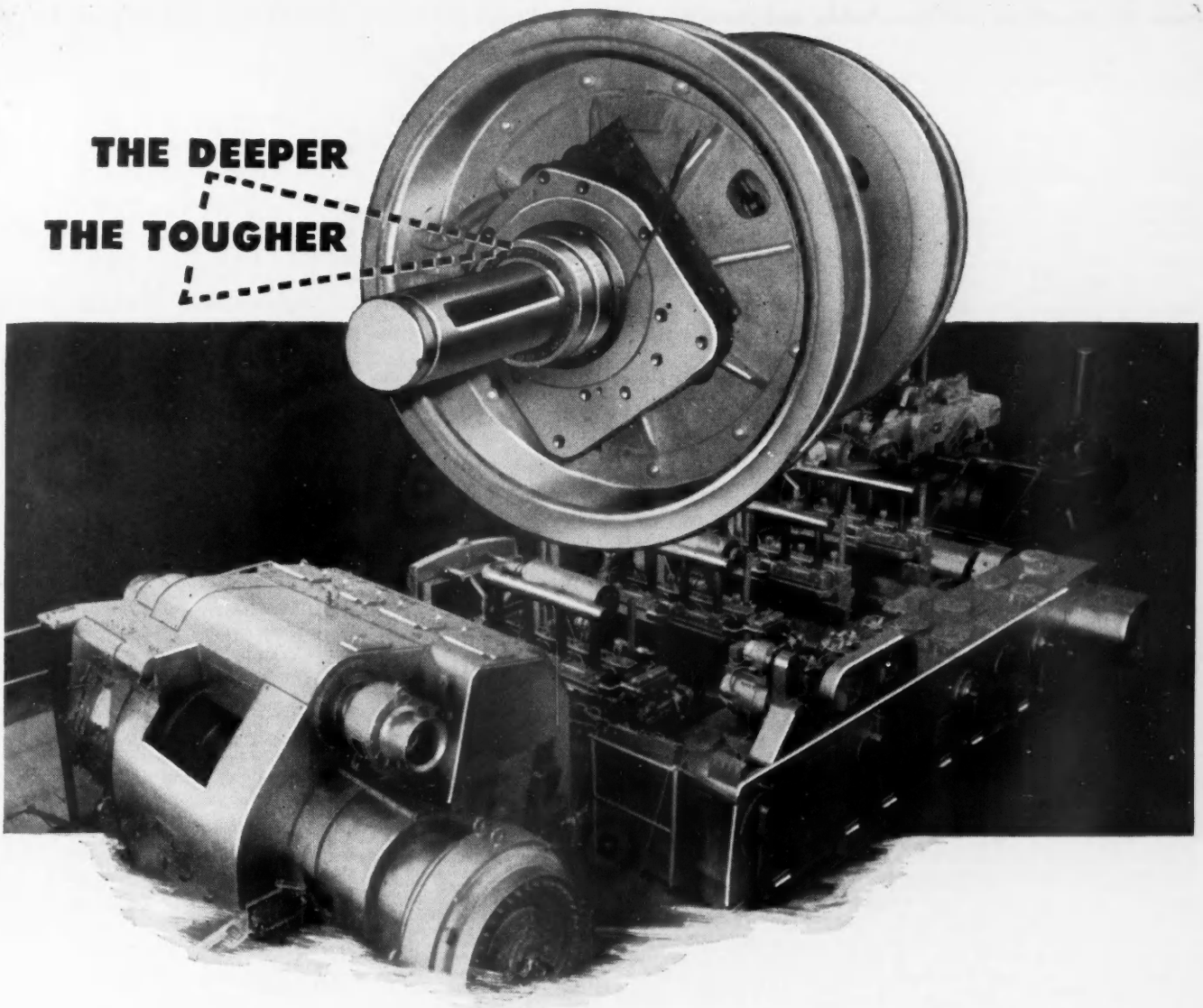
New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in August, 1950

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		ARKANSAS—New Oil Field						
Union	New London, N.	Marine Oil Co's Trigg 1, C NW NE 33-17s-12w. 1 mi e new London	8- 6-50	6153	4422- 4432	Cotton Valley sd; Jur.	P 75; 100 wtr ¼"	....
		CALIFORNIA—New Oil Fields						
Los Angeles		The Texas Co's Honor Farm NCT 1, Sect. 6-4n-16w. 3 mi ne Castaic fld.	8-22-50	6038	5269- 5418		F 283; 5/16"	37.3
San Luis Obispo		Hancock Oil Co's Hancock Bishop 44-31, Sect. 31-30s-20e. 2¾ mi nw Morales fld.	8-22-50	6235	5785- 6020		P 255	36.8
		CALIFORNIA—Gas Field Extension						
Kern	Trico	Harry H. Magee's Pacific Comm. 1, Sect. 7-25s-24e. 1 mi se extension	8-20-50	3304	3243- 3251	San Joaquin clays; Plio.	0.3 mln; 3/8"	....
		COLORADO—New Oil Fields						
Logan	Merino	Trigood Oil Co's Couch 1, SE SE SE 19-6n-54w	7-30-50	5391	5120- 5121	Dakota sd; U. Cre.	P 250; 30 wtr	38.6
Morgan		Adams Drlg. Co. & J. M. Huber Corp's C. S. Lee 2, SW SE NE 2-2n-57w.	8-13-50	5478	5444- 5452	Muddy sd; U. Cre.	P 144	39.4
		ILLINOIS—New Oil Fields						
Gallatin	Inman, S	Arnold Valter's L. B. Drone 1, NE NE NE 27-8s-9e 1¼ mi w Inman fld.	8- 8-50	2494	2474- 2486	Cypress sd; Miss.	P 35	....
Wayne	Ellery, W	Skiles Oil Corp's Allison 1, SW SW NW 23-2s-9e. 1½ mi ne Goldengate Cons. fld.	8-22-50	3317	3270- 3287 3307- 3312	L. OHara li; Miss. Rosiclare li; Miss.	P 285; 5 wtr	....
		ILLINOIS—New Oil Pays						
Edwards	Maplegrove, E.	Miracle & Steber's J. A. Weir 1, NW NW SW 12-1n-10e	8-22-50	3215	2397- 2408	Waltersburg sd; Miss.	P 58; 3 wtr	....
Lawrence	Helena	Gopher Drlg. Co's E. Stout et al 1, SW NW SW 1-2n-13w. 1 mi ne prod.	8- 8-50	2460	2386- 2396	McClosky li; Miss.	P 10; 1 wtr	....
		ILLINOIS—Oil Field Extensions						
Edwards	Maplegrove, E.	J. Bander et al's Vaughn 1, SW NW SE 12-1n-10e. ½ mi sw extension	8-22-50	3272	3200- 3205	L. O'Hara li; Miss.	P 25	....
Edwards	Maplegrove, E.	J. W. Rudy's M. Koenecke 1, SE NW NW 12-1n-10e. ½ mi w extension	8- 8-50	3211	3202- 3211	McClosky li; Miss.	P 75; 2 wtr	....
Hamilton	Rural Hill	Stewart Oil Co's M. Cluck 1, NE SW NW 9-6s-6e. ½ mi e extension	8-22-50	3104	3076- 3099	Aux Vases sd; Miss.	P 207; 10 wtr	....
Richland	Clay City-Noble Cons.	Skiles Oil Corp's C. D. Watkins 1, NE NW 11-3n-9e. ¾ mi e extension	8- 1-50	2964	2956- 2964	Rosiclare li; Miss.	F 370	....
Richland	Clay City-Noble Cons.	Miracle & Steber's C. Curry 1, SW SW 11-3n-9e. ½ mi s eextension	8-15-50	2957	2949- 2957	Rosiclare li; Miss.	F 475	....
Wayne	Johnsonville, W.	National Assoc. Pet. Co's B. E. Richardson A-1, NE NE NE 22-1n-5e. 1¼ mi nw extension.	8- 8-50	2897	2879- 2886	Aux Vases sd; Miss.	P 30	....
White	Phillipstown Cons.	J. Buchman's Sturm 1, SE SW NE 36-3s-10e. ¾ mi w extension	8-29-50	3163	3096- 3106	L. O'Hara li; Miss.	P 246	....
		INDIANA—New Oil Fields						
Gibson		Sam Garfield's Roy Wilderman 1, NW NW NW 31-2s-9w. 2 mi s Francisco.	8- 8-50	1845	1837- 1843	Aux Vases li; Miss.	P 240	....
Gibson		Noah Pet. Co's Mumford Fms 2, NW NW NW 27-3s-13w. 8 mi sw Owensville.	8-25-50	2444	2435- 2444	Cypress sd; Miss.	P 75	....
Knox	Monroe City, N.	H&V Oil Co. et al's Kensler & Dreiman 1, Mil Don 40-3n-9w. 3 mi nw Monroe City.	8- 6-50	1470	1466- 1470	Aux Vases li; Miss.	P 70	....
Sullivan		Carter Oil Co's Herbert Drake 1, NW SE SE 14-9n-10w. 8 mi nw Sullivan	8-25-50	2258	2141- 2258	Devonian li; Devo.	P 180	....
Vanderburgh		G. L. Reasor's H. P. Strott 1, SW NW NE 11-5s-11w. ¾ mi n Dramstadt fld.	8-19-50	2470	2455- 2470	O'Hara li; Miss.	P 140	....
		INDIANA—New Oil Pays						
Gibson	Lyles	T&H Corp's Deep Vein Coal 1, SW SE NW 1-2s-12w	8- 4-50	2802	2720- 2743	Salem li; Miss.	P 40	....
Pike	Union-Bowman	W. Usrey & John Organ's R. Belcher 1, W½ SE NE 27-1s-9w	7-26-50	2100	1526- 1544	O'Hara li; Miss.	P 50	....
		KANSAS—New Oil Fields						
Barton	Hammeke,SE.	Honaker Drlg. Co's Birzer 1, NW NW SE 17-19s-11w. Ne of Ellinwood	8-20-50	3380	3089- 3096	Lansing-KC. li; Penn.	F 1267	....
Graham	De Young	C-G Drlg. & D. G. Hansen's De Young 1, SW SW SW 35-9s-21w. 2 mi s Morel fld.	8-15-50	3839	3826- 3839	Arbuckle li; Ord.	P 3000	....
Greenwood		C. W. Darling's Johnson 1, CNL SE SE 32-26s-11e	8-17-50	1876	1862- 1876	Miseissippi li; Miss.	P 50	27
Rooks	Grover	Anschutz Drlg. Co's Grover 1, CEL NE NE 22-7s-19w. 2 mi ne Webster	8-22-50	3427	3272- 3303	Lansing li; Penn.	P 143	....
Rooks	Laura	Heathman Drlg. Co's Raymond 1, NW NW NW 30-10s-20w. 2 mi se Morlan fld.	8-21-50	3708	3705- 3708	Arbuckle li; Ord.	P 124	30
Russell	Russell, NE.	Lewis Drlg. Co's Streck 1, SW SE NW 26-13s-14w. ¾ mi ne Russell fld.	8- 5-50	3275	3272- 3275	Arbuckle li; Ord.	P 240	....
Stafford	Katchelman	J. M. Huber & Pabco Drlg. Co's Kachelman 1, SE SE SW 7-25s-13w. 2 mi ne Kipp, NE. fld.	8- 7-50	4086	4074- 4086	Viola li; Ord.	P 166	....
Stafford	Van Winkle	Crown Oil Co's Van Winkle 1, NW SW SW 23-21s-14w. 2 mi w Pundsack fld.	8-23-50	3784	3501- 3574	Lansing-KC. li; Penn.	P 75	....
Sumner	Fall Creek	The Texas Co's Hobbisiefkin 1, SW NE SW 3-35s-3w. 2 mi ne Caldwell fld.	8-19-50	4779	4728- 4779	Simpson dolo; Ord.	F 3000	....
		KANSAS—New Oil Pay						
Rice	Mary Ida	Sohio & Derby's Reif 1, (OWWO), NW NE SW 31-18s-10w	8-16-50	3279	3033-3035	Lansing-KC. li; Penn.	F 481; ¼"	....
		KANSAS—Oil Field Extension						
Butler	Semisch	McClure & McGinnis' Hartenbower 1. C N½ NE NW 16-29s-6e. ¾ mi s extension.	8-17-50	3298	2450- 2480	Peru sd; Penn.	P 30	....
		KENTUCKY New Oil Fields						
McLean		R. Hal Compton's Will Clines 1, 4-N-26	8-17-50	1954	1922- 1954	Cypress sd; Miss.	P 32	....
McLean	Beach Grove	Felmont Oil's J. H. Hayden 1, N½ SW NE SE 13-N-26. 1½ mi e Beach Grove.	8-20-50	2572	1680- 1700	Waltersburg sd; Miss.	P 40	....
Webster		Delta Drlg. et al's Townsend 1, SW SE SW 20-N-22. 1 mi ne Tilden	8- 7-50	1927	1900- 1925	Tar Springs sd; Miss.	P 121; 15 wtr	....
		KENTUCKY—Oil Field Extension						
Union	Caney Mound	Delta Drlg. et al's Uniontown Bank 1, S½ NE SE SW 8-P-20. ½ mi ext.	8- 7-50	2626	2500- 2506	L. O'Hara li; Miss.	P 80; 80 wtr	....
		NORTH LOUISIANA—New Oil Field						
Concordia	Deer Park	Carter Oil Co's Clyde C. Graham 1, SE NE 48-5n-9e. 1 mi s&e Deer Park	8-25-50	6710	5976- 5982	Wilcox sd; Eoc.	F 360; ¼"	47
		NORTH LOUISIANA—New Oil Pay						
Webster	Sibley	Skelly's Reed Unit B-1, Sect. 4-17n-9w	8-24-50	5676	5416- 5598	Hill-Davis sd; Cre-Jur.	F 138; ¾"	35.2
		NORTH LOUISIANA—New Gas Pay						
Caddo	Waskom-Greenwood	W. J. Hunter's Jackson Hrs 1, C SE SE 9-17n-16w	8-16-50	3786	2798- 2816	Paluxy sd; L. Cre.	F 1.3 mln; ¼"	....
		SOUTH LOUISIANA—New Oil Field						
E. Baton Rouge		Shell's Vivan J. Gianelloni 1, Sect. 47-8s-1e. 5¼ mi ne Sunshine fld.	8-13-50	12100	10876-10890		F 370; 3/32"	47.6
		SOUTH LOUISIANA—New Oil Pay						
Calcasieu	Phoenix Lake	Ohio Oil Co's E. W. Brown, Jr. 3, C SW SW 21-11s-13w	8- 5-50	8066	7986- 7990	"B" sd; Mio.	F 251; 11/64"	42.4
		SOUTH LOUISIANA—New Distillate Pays						
Pointe Coupee	Fordoche	The Texas Co's J. W. Green Sr. 2, Sect. 27-6s-8e	8-12-50	9629	9066- 9084		302; 7.8 mln; 3/4"	58
Terrebonne	Turtle Bayou	Shell's Continental Ld & Fur Co. 3, C NE SE 28-17s-14e	9- 6-50	12758	6414- 6434		325; 1.5 mln; 3/8"	33
		MICHIGAN—New Oil Fields						
Isabella		F. T. Rand & C. W. Collin's Albar 1, NW NW NW 20-14n-4w	7-28-50	3195	3118- 3195	Traverse li; Devo.	P 85	....
Oceana		P. K. Degenther's State-Otto 1, (OWWO), SE SE SE 32-13n-16w	8-19-50	1895	1445- 1464	Berea sd; Miss.	P 4	....
Osceola	Fork Dundee	Irvin W. Hartman's Manley 1, SE NE SE 33-17n-7w	8-20-50	3792	3788- 3792	Dundee li; Devo.	F 120	....
		MICHIGAN—Oil Field Extension						
Newaygo	Bishop	Fish, McMillan, Chopard & Howard's Frens 1, SE NE SW 30-12n-13w. 1 mi s extension.	8-20-50	2221	2219- 2221	Traverse li; Devo.	F 15	....
		NEBRASKA—Oil Field Extension						
Cheyenne	Huntaman	Deep Rock-Frontier Rfg's Siemers 1, SW SW NW 6-14n-49w. ½ mi ne ext.	8-20-50	4845	4823- 4825	"J" sd.	P 181	....
		OKLAHOMA—New Oil Fields						
Carter		Shell's Finston-Neustadt 1, NE SW SW 29-2s-3w. ¾ mi n old Healdton fld.	8-22-50	7668	6720- 6756	Tussy sd; Penn.	F 99; open	50.2

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke in inches.



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New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in August, 1950

(CONTINUED)

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
McClain	Washington, N.	Greenbrier Oil Co's Wentzel 1, NE NW NW 33-8n-3w. 2 mi sw Goldsby, SW. fld.	8-20-50	11595	10665-10745	Bromide sd; Ord.	F 333; 3/8"	44
Oklahoma		Ashland O&R Co's Shannon 1, NW NW SE 6-14n-2w	8-18-50	5990	5971- 5990	Bartlesville sd; Penn.	F 153; 3/8"	....
Oklahoma		Peppers Refg. Co's Wegener 1, NW NW NW 23-12n-2w. 2 mi s Munger	8-19-50	6620	6388- 6404	Bois D'Arc li; Devo.	P 47	....
Stephens		Big Chief's Harley 1, SW SW NW 8-2s-6w	8-21-50	3862	3162- 3181	Pennsylvanian sd; Penn.	P 60; 18 wtr.	34
		OKLAHOMA—New Oil Pays						
Creek	Mannford	Woods-Gilchrist's Woody 1, SW SE SE 2-18n-8e	8- 3-50	2493	2444- 2468	Red Fork sd; Penn.	F 185; 3/32"	38
Lincoln	Tryon, NW	Dan Dunlap & A. Silberman's Abraham 1, NW NW NW 11-16n-3e	8- 7-50	4143	4120- 4143	Skinner sd; Penn.	F 112; 7/32"	....
		OKLAHOMA—Oil Field Extensions						
Creek	Cushing	Thompson Drlg. Co's Landrum 1 (OWWO) NE SW NE 29-19n-7e. ¾ mi. n extension.	8- 4-50	3005	2767- 2769	Red Fork sd; Penn.	P 1; 9 wtr	....
Lincoln	Sac-Fox	Zephyr Pet. & Alpha Pet. Co's Criess 1, NW SE SW 2-14n-6e. 1 mi n & ¾ mi w extension.	8- 7-50	2960	2931- 2960	Prue sd; Penn.	F 20	....
Major	Ringwood	Mazda Oil Co's Harman 1, NE NW NW 16-21n-10w. 1¾ mi s extension	8-10-50	7131	6858- 6978	Manning sd; Penn.	F 147; 11/64"	40
Pottawatomie	Maud	Olson Drlg. Co's Moore 1-A, NE NE SW 7-8n-5e. n extension	8-21-50	3713	3703- 3713	Earlsboro sd; Penn.	F 115	39
		OKLAHOMA—New Gas Fields						
Cleveland		Benson & Montin's Pearcy 1, SW SW SE 30-6n-1e	8-25-50	6851	5790- 5808	Deese sd; Penn.	6.5 mln; 1"	....
Hughes		Deep Rock's Eckles 1, NE SW NW 12-7n-11e	8-17-50	4062	3905- 3928	Jefferson sd; Penn.	7.6 mln; open	....
		OKLAHOMA—Gas Field Extension						
Hughes	Greasy Creek	Fred C. Summer's Unstead 1, NE NE NE 35-8n-10e	8-27-50	2614	2557- 2573	Hartshorne sd; Penn.	4.5 mln.	....
		TEXAS—District 1 (SOUTH CENTRAL)—New Oil Field						
Dimmitt	"Rocky Creek"	J. C. McCabe et al's Mayflower Inv. Co. 1, Sur. 667, 7 mi nw Carrizo Springs.	8-16-50	3015	2114- 2124		P 59	29
		TEXAS—District 1 (SOUTH CENTRAL)—New Distillate Field						
McMullen		Delbi Oil Corp's Lula W. Pursch et al 1, BS&F Sur. 12 mi ne Freer	8- 3-50	8009	7165- 7170		no gge.	....
		TEXAS—District 2 (MIDDLE GULF)—New Oil Fields						
Bee		Well Serv. & Drill Co's J. H. O'Connor 1, Phoebe Crain Sur. 4 mi n Skidmore	8- 1-50	4260	4218- 4236		F 128; 3/32"	23.5
Jackson	"Wajack"	Gulf South Oil Corp's Wm. Niebuhr et al 1, T. M. Dorsett Sur. 15 mi sw El Campo.	8- 1-50	6215	5736- 5740		P 103; 1/8"	33.8
		TEXAS—District 2 (MIDDLE GULF)—New Oil Pay						
Victoria	McFaddin, E.	Union Prod. Co. et al's McFaddin et al 20-A, C. O. Edwards Sur.	8-20-50	6015	5643- 5647		F 152; 1/8"	38.6
		TEXAS—District 2 (MIDDLE GULF)—New Gas Fields						
De Witt		Deep Rock's Edwin Nagel 1, Mumford House Sur.	8- 2-50	8717	7675- 7695		no gge.	....
Jackson		Big 6 Drlg. Co's Bishop Griffin 1, Tacitus Clay Sur. 1¾ mi ne Collier fld.	8-26-50	3007	2417- 2421		49 mln; open	....
		TEXAS—District 2 (MIDDLE GULF)—New Gas Pays						
Goliad	Berclair	Magnolia's John P. Forrest 1, Sampson McTornall Sur.	8-12-50	3350	2781- 2789		1.6 mln; open	....
Jackson	Collier	Fred W. Shield's Laughter 1, Jas. Kerr Sur.	8-15-50	5218	3992- 4002		13.5 mln; open	....
		TEXAS—District 3 (UPPER GULF)—New Oil Field						
Hardin		Sohio's Nono Mills 1-B, WCRR Sur. 5 mi sw Kountze	8-22-50	9212	7646- 7652	Cockfield "B" sd; Eoc.	F 102; 1/8"	32.6
		TEXAS—District 3 (UPPER GULF)—New Oil Pays						
Austin	New Ulm	Oil Drilling Inc's Selma Holzman 1, A. Kuykendall Sur.	8-27-50	10111	9638- 9655		no gge.	....
Brazoria	Nash	Dan J. Harrison, Jr's Belle Wisdom Est. 3, H. N. Cleveland Sur.	8- 5-50	4114	4110- 4113	Miocene	F 115; 3/64"	20.5
Galveston	Hitchcock	Stewart Pet. Co's State-Highland Bayou 2, John D. Moore Lge.	8-29-50	6800	5304- 5310		F 41; 1/8"	36.4
Harris	Aldine, S.	F. M. Corzelius' H. H. Rath 2 (OWWO), W. Sevey Sur.	8- 2-50	7773	7088- 7091		F 67; 3/64"	36.6
Matagorda	Midfield	Sun's St. Louis Brownsville Corp. 2, I&GN RR Co. Sur. 2	8- 4-50	11106	10446-10452	L. Frio sd; Olig.	F 223; 1/8"	42.6
Orange	Orange	Wayside Oil & Paul Cormier's Gulfs Lee Hager Fee 1, S. M. Luce Sur.	8- 6-50	6319	5160- 5164		F 127; 1/4"	34.4
Polk	Livingston	Humble's D. A. Honaker 1, (OWWO), A. Virsca Sur.	8-22-50	6744	3748- 3760		F 9; 1/8"	32
Washington	Clay Creek	Newman Bros. & Alaska Steamship Co's Ida Rosenbaum 2, Nestor Clay Lge.	8-15-50	6330	5098- 5108		F 142; 1/32"	44.2
		TEXAS—District 3 (UPPER GULF)—New Distillate Fields						
Brazoria		Skelly's E. O. Koutnik 1, W. D. C. Hall Sur. 5 mi s Sandy Point fld.	6-15-50	9340	7528- 7529		23;0.7 mln.1/4"	....
Newton		Callery & Hurt's T. E. Inman et al 1-A, Willis Donaho Sur. 2½ mi se Bon Weir.	8-25-40	12215	10650-10670		296; 1.5 mln. 1/4"	52
		TEXAS—District 3 (UPPER GULF)—New Gas Field						
Madison		J. M. West's J. W. Mathis, Jr. 1, Arter Crownover Sur. 7 mi w Madisonville	8-23-50	10045	8260- 8270		no gge.	....
		TEXAS—District 3 (UPPER GULF)—Gas Field Extension						
Galveston	Hitchcock	Stewart Pet. Co's M. Stewart 22, Jas. Spillman Sur. 1 mi s extension	8- 2-50	7882	5413- 5419	Miocene	5.9 mln; open	65
		TEXAS—District 4 (LOWER GULF-S.W.)—New Oil Fields						
San Patrio	"East Sinton"	Superior's J. F. Odem et al 1, John Henderson Sur. 1¼ mi ese Sinton fld.	8-15-50	8344	6650- 6660		F 122; 1/8"	39
Webb		O. W. Killam's Floyd Billings 2, CCSD&RGNG Sur. 16 mi n Bruni	8-17-50	2405	2393- 2405		F 65; 1/16"	31.9
		TEXAS—District 4 (LOWER GULF-S.W.)—New Oil Pays						
Duval	Palangana	Crescent Oil Co's Cain & Smith 1, GH&H Sur.	8-22-50	452	444- 452		P 25	....
San Patrio	W. Sinton—Shallow	Payne & Riggs' J. G. Moss 6, Blk 23, John Pollan Lge.	8- 2-50	2406	2039- 2043		F 115; 1/32"	21
San Patrio	"Triple A"	J. S. & R. H. Abercrombie & Atlantic's L. E. Fite 1, Robt. Saddler Sur.	8-15-50	7455	7148- 7150		F 111; 11/64"	44.5
		TEXAS—District 4 (LOWER GULF-S.W.)—New Distillate Field						
Nueces		Shell's State Tr. 342-1, Red Fish Bay, 4 mi se Ingleside.	8-21-50	9803	7629- 7640		53; 5.8 mln.1/16"	53.8
		TEXAS—District 4 (LOWER GULF-S.W.)—New Gas Fields						
Starr		Hugh Kirkpatrick et al's Eduviges Alvares 1, Santa Teresa Gr. 1½ mi n San Yzidro.	8-24-50	6033	4590- 4625		20 mln; open	....
Webb		Magnolia's Lopez Est. 1, NW¼ T&NO RR Sur.	8-19-50	6706	1409- 1418		8.4 mlm; open	....
		TEXAS—District 4 (LOWER GULF-S.W.)—New Gas Pay						
Brooks	Mariposa	Frank W. Michaux & Sterling O&R Co's D. J. Sullivan 1, Loma Blanca Gr.	8- 2-50	9003	6543- 6552		9.9 mln; open	....
		TEXAS—District 7-C—(WEST CENTRAL)—New Oil Field						
Runnels		J. D. Andrews et al's Ray V. Willis 1, G. Hancock Sur. 6 mi sw Lawn	7-28-50	2690	2670- 2690	Surratt sd; Penn.	P 131	40.5
		TEXAS—District 7-C—(WEST CENTRAL)—New Oil Pay						
Crockett	Midway Lane	Sinclair's Univ. 7-67, Sect. 30, Blk 46, Univ. Lds. Sur.	8-22-50	1129	1076- 1100	Queen sd; Perm.	F 33; 1/2"	28
		TEXAS—District 7-C—(WEST CENTRAL)—Oil Field Extension						
Runnels	Winters	J. K. Wadley-T. M. McMurray's G. C. Davis 1, Sect. 329, Blk 64, K&TC Sur.	7-22-50	3624	3618- 3624	Palo Pinto sd; Penn.	F 217; 1/2"	42
		TEXAS—District 7-C (WEST CENTRAL)—New Gas Fields						
Crockett		H&F Oil Co's Shannon Est. 1-A, Lge 4, Archer CSL Sur.	8-21-50	2502	1832- 2078		6 mln.	....
Runnels		O. W. Killam's J. P. Knight 2, Sect. 346, BBB&C Sur. 7 mi sw Winters	8-18-50	4015	3959- 3963	Gray sd; Perm.	4.9 mln; 1/2"	....
		TEXAS—District 8 (WEST)—New Oil Fields						
Borden		Vickers Pet. & Norwood Drlg.'s J. R. Canning 1-A, Sect. 142, Blk 25, H&TC Sur.	7-26-50	5937	5912- 5937	Wolfcamp li; Perm.	F 1267; 23/64"	41
Crane	"Robbins"	Union Sulphur's R. B. Robbins et al 1, Sect. 27, Blk 35, H&TC Sur. 1 mi nw Crossett fld.	8-25-50	5503	3407- 3419	U. Clear Fork sd; Perm.	F 55; 1/4"	40.6
Gaines		Stanolind's Nick Alley 1, Sect. 22, Blk A-27, PSL Sur. 1 mi se Boydell	8- 4-50	11187	4130- 4585	San Andres li; Perm.	P 7; 27 wtr.	27
Howard		Shell's M. H. O'Daniel 1, Sect. 2, Blk 30, T-1-N, T&P Sur. 5 mi n Iatan-E. Howard fld.	8-10-50	8780	7995- 8005	Canyon Reef li; Penn.	F 404; 3/8"	46
		TEXAS—District 8 (WEST)—Oil Field Extensions						
Gaines	Doss	Humble's Fee-Eubank B-1 (OWWO), Sect. 6, Blk AX, G.H. Eubank Sur. ¾ mi n extension.	6-20-50	10255	6830- 6885	Clear Fork sd; Perm.	F 103; 2"	36
Pecos	Malicky	B. F. Weekley & W. W. Allman's L. L. Borgens 1, Sect. 14, Blk 9, H&GN Sur. 1 mi w extension.	7-17-50	2088	2021- 2088	Dela. Mt. sd; Perm.	P 28; 122 wtr.	31.7
		WYOMING—New Oil Fields						
Converse		S. W. McLaughlin's State 1, NW NE SE 7-32n-76w. 6 mi s Big Muddy fld.	8-21-50	5815	5090- 5140	Dakota sd; U. Cre.	P 100	....
Weston		Lakota Pet.'s Sterling 1, SW NE SW 6-45n-66w. West Hay Crk area	8-14-50	6421	6396- 6414	Newcastle sd; U. Cre.	F 132; 1/16"	....
Weston		Lodgepole Dev. Co. & Schlaijker's State 1, NE NW SW 16-43n-65w.	8- 5-50	6168	6121- 6136	Newcastle sd; U. Cre.	F 42	....
		WYOMING—New Oil Pay						
Washakie	Worland	Pure's Unit 7 (OWWO), C SW SW 21-48n-92w	8-21-50	10028	7108- 7376	Frontier sd; U. Cre.	F 125	54

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw) or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke in inches.

Well Blowouts In California Drilling

Part 1

By A. J. HORN
Petroleum Engineer, Standard Oil Company of California

HISTORIES of 55 of the 65 blowouts occurring in California over a 10-year period are studied and drilling practices previous to the blowouts analyzed. Based on this investigation, some precautions are suggested for preventing uncontrolled flow of formation fluids. This paper, substantially as reproduced, was presented before the Spring Meeting, Pacific Coast District, API Division of Production.

BLOWOUT! is a dangerous and expensive accident in oil well drilling operations. Several excellent papers have been published on the general subject but, except for articles on spectacular individual wells, no previous general survey has yet been made concerning the subject of blowouts in California.

A blowout in oil and gas well drilling operations may be defined as that loss of control over formation pressure which causes an unrestrained flow of mud, oil, gas, or water at the surface accompanied by *potential* injury to personnel, loss of hole or equipment, or other appreciable damage.

In practice, however, this definition of a well blowout has not been applied to the following investigation. In many cases to the author's knowledge some drilling fluid has been momentarily blown out of a well, but immediate use of blowout control equipment or continued circulation prevented complete loss of control over the formation pressure and hence actual injury or damage. Therefore, the blowouts reported herein are necessarily limited to those which *actually* resulted in injury to personnel, loss of hole or equipment, considerable consternation, or other serious situations. These are the accidents which attract publicity and remain in the memories of drilling people.

Drilling operations considered in this study include the drilling, redrilling, or deepening of new wells or former producers and the necessary completion operations for testing or producing from objective horizons.

Sixty-six well blowouts involving 30 companies and operators have occurred in California drilling operations during the 10-year period from 1940 to 1949. During this decade, approximately 18,000 oil and gas wells were drilled. Including all exploratory operations and limiting the development operations to those fields where blowouts were actually experienced, these 66 well blowouts took place during the drilling of approximately 7550 wells. This amounts to 0.8 percent. Of the 66 blowouts, 34 occurred in drilling development wells, 29 occurred while drilling exploratory wells, and three were unspecified as to time or location (see Figure 1 and Table 1).

In development operations in those fields experiencing blowouts, the percentage of well blowouts to wells drilled was 0.6 percent for the 10-year period from 1940 to 1949. During 1944, a peak of 10 blowouts occurred, amounting to 1.4 percent of the development wells drilled. Since then, however, the number and percentage of blowouts in development drilling has been steadily increasing.

In exploratory operations, the percentage of well blowouts to wells drilled was 1.4 percent for the 10-year period, or about 3 times the percentage in development drilling. The peak of almost 5 percent occurred in 1941, although high percentages also occurred in 1944 and 1947. The number and percentage of blowouts in exploratory operations also has been decreasing during the 10-year period, but the trend since 1944 is not as regular as for development wells.

Parenthetically, the large number of blowouts in 1944 is believed to have been caused by (1) a rapid increase in exploration activities, (2) an increase in development extension and inter-drilling, and (3) the replacement of experienced drilling people, lost to other war services, by personnel not familiar with California drilling conditions.

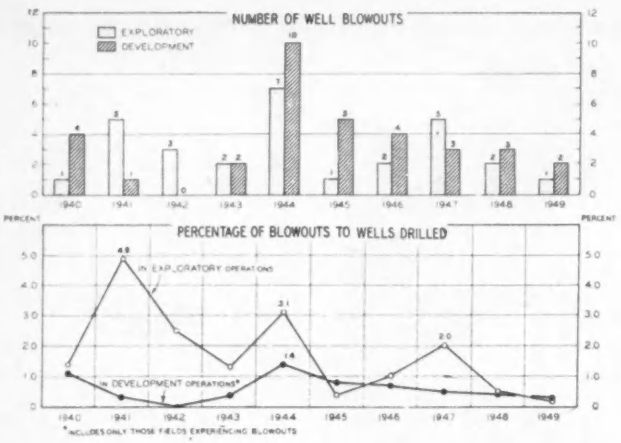
As might be expected, the percentage of blowouts to wells drilled was considerably higher for gas well drilling than for oil well drilling—3.4 percent for gas wells and 0.7 for oil wells (see Table 2). Surprisingly, however, a significantly higher percentage of blowouts occurred in gas development drilling (4.0 percent) than in gas exploratory drilling (3.1 percent).

Well histories of 55 of the above mentioned cases were sufficiently complete to permit a study of drilling practices preceding the well blowouts. These have been analyzed from the standpoint of determining causes of such blowouts and their relative significance. Based on this investigation, some precautions are suggested for preventing the uncontrolled flow of formation fluid which results in well blowouts.

Causes of Well Blowouts

Control of Formation Fluid Pressure

It is obvious that the pressure exerted by the drilling fluid column must be greater than the pressure of the forma-



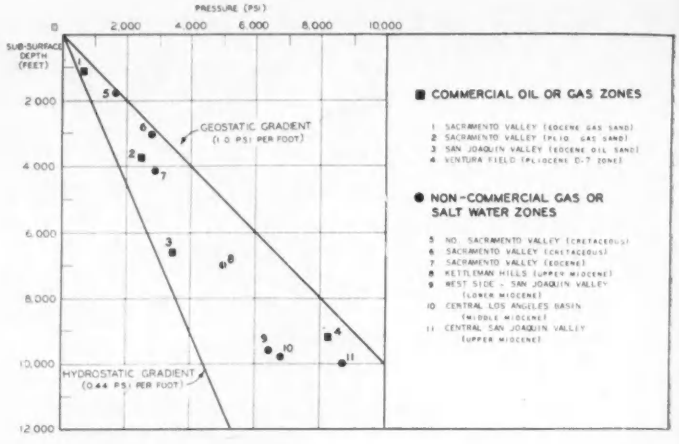

PRESSURE (PSI)
SUB-SURFACE DEPTH (FEET)
GEOSTATIC GRADIENT (1.0 PSI PER FOOT)
HYDROSTATIC GRADIENT (0.44 PSI PER FOOT)
COMMERCIAL OIL OR GAS ZONES
1 SACRAMENTO VALLEY (EOCENE GAS SAND)
2 SACRAMENTO VALLEY (PLIO. GAS SAND)
3 SAN JOAQUIN VALLEY (EOCENE OIL SAND)
4 VENTURA FIELD (PLIOCENE D-7 ZONE)
NON-COMMERCIAL GAS OR SALT WATER ZONES
5 NO. SACRAMENTO VALLEY (CRETACEOUS)
6 SACRAMENTO VALLEY (CRETACEOUS)
7 SACRAMENTO VALLEY (EOCENE)
8 KETTLEMAN HILLS (UPPER MIOCENE)
9 WEST SIDE - SAN JOAQUIN VALLEY (LOWER MIOCENE)
10 CENTRAL LOS ANGELES BASIN (MIDDLE MIOCENE)
11 CENTRAL SAN JOAQUIN VALLEY (UPPER MIOCENE)

FIGURE 1 (left). Well blowouts in California drilling operations.
FIGURE 2 (right). Depth-pressure relationships for high-pressure zones encountered in California drilling.

tion fluid at any depth in order to prevent the formation fluid from flowing into the bore hole and to the surface. The pressure of the drilling fluid column at any depth is usually considered to depend solely on the height of the column at that depth and on the density of the drilling fluid. The basic cause of well blowouts, therefore, is an insufficient static head in the drilling fluid column to adequately exceed the formation pressure.

The maintenance of control over the formation pressure may be divided into the following:

1. Primary control. A function of the drilling fluid, as determined by the fluid density and the column height.
2. Secondary control. A function of surface blowout control equipment for shutting in a well.

The installation of surface equipment with an adequate well casing program is of great value, but it can only be used to control a well blowout after failure of primary control by the drilling fluid.

Formation Fluid Pressure Considerations

It is generally agreed that original formation fluid pressures of productive zones in California are normally equivalent to the static head of a salt water column to the surface or to the height of the water table in the formation outcrop. This depth-pressure relationship results in a normal pressure gradient of approximately 0.44 pounds per square inch per foot. From published data the pressure gradients in California fields are found to range usually from 0.418 to 0.524 psi per foot for oil reservoirs and from 0.405 to 0.486 psi per foot for gas reservoirs.

In several areas, gas or salt water sands have been encountered with pressure gradients considerably in excess of the hydrostatic gradient and higher than those of overlying and underlying oil and gas zones. Based on the drilling fluid density necessary to prevent extraneous fluid entry, two wells in the Sacramento Valley penetrated permeable Cretaceous sandstones having pressure gradients approximately equivalent to the geostatic (or overburden) gradient of 1.0 psi per foot. Several examples of excessive pressures encountered in California drilling are indicated in Figure 2. For a summary of possible reasons for abnormal formation pressures, reference is made to a recent study by E. V. Watts[1] pertaining to the Ventura Avenue field.

It may be concluded from the above data that a drilling fluid density of 76 pounds per cubic foot should be sufficient to balance the original formation pressure in most of the oil or gas zones in California fields. On the other hand, the presence of abnormally high formation pressures in permeable intervals above the objective zone has required drilling fluid densities of 87 to 126 pounds per cubic foot (and occasionally higher) to balance the formation pressure safely.

The 55 well blowouts investigated in this study were found to have been caused by one or a combination of the following factors in the loss of primary control.

1. Reduction in fluid level by lost circulation.
2. Insufficient drilling fluid density.

TABLE 1
Well Blowouts In California Drilling Operations (1940-1949)

YEAR	Number of Wells Drilled (a)	Number of Blowouts (b)	Percentage of Blowouts To Wells Drilled	Wells Drilled Per Blowout
DEVELOPMENT (a)				
1940	349	4	1.1	87
1941	360	1	0.3	360
1942	223	0	0.0	223
1943	551	2	0.4	276
1944	708	10	1.4	71
1945	618	5	0.8	124
1946	559	4	0.7	140
1947	607	3	0.5	202
1948	769	3	0.4	256
1949	675 (c)	2	0.3	337
Total	5419	34		
Avg.	.....	.....	0.6%	160
EXPLORATORY				
1940	74	1	1.4	74
1941	103	5	4.9	21
1942	118	3	2.5	39
1943	159	2	1.3	79
1944	228	7	3.1	33
1945	226	1	0.4	226
1946	206	2	1.0	103
1947	252	5	2.0	50
1948	267	2	0.5	183
1949	400 (c)	1	0.2	400
Total	2133	29		
Avg.	.....	.....	1.4%	73

(a) Division of Oil and Gas, Summary of Operations, Vols. 26-34 inclusive. For development wells, only those fields experiencing well blowouts during this period are included.
(b) Does not include three blowouts unspecified as to time or location.
(c) Estimated.

TABLE 2
Well Blowouts in California Drilling Operations (1940-1949)

Nature of Objective Zone	Number of Wells Drilled (a)	Number of Blowouts (b)	Percentage of Blowouts To Wells Drilled	Wells Drilled per Blowout
DEVELOPMENT (a)				
Oil.....	5269	28	0.5%	190
Gas.....	150	6	4.0%	25
Total...	5419	34		
Average	.....	.....	0.6%	160
EXPLORATORY				
Oil.....	1813	19	1.0%	96
Gas.....	320	10	3.1%	32
Total...	2133	29		
Average	.....	.....	1.4%	73
ALL WELLS				
Oil.....	7082	47	0.7%	150
Gas.....	470	16	3.4%	29
Total...	7552	63		
Average	.....	.....	0.8%	120

(a) Division of Oil and Gas, Summary of Operations, Vols. 26-34, inclusive. Wells drilled in 1949 are estimated. For development wells, only those fields experiencing well blowouts during this period are included.
(b) Does not include three blowouts unspecified as to time or location.

3. Reduction in static pressure by pipe withdrawal.

Failure to keep hole full of fluid.

The importance of these factors in well blowouts was determined by classifying each blowout according to *principal cause* and *contributing cause,* depending on the estimated proportion of pressure reduction obtained in each case. The percentage of well blowouts attributable to each of the above factors in primary control failure is summarized in Figure 3 and Table 3.

Reduction in Fluid Level by Lost Circulation

A loss of circulation to the surface will cause a reduction in height of the mud column and, therefore, a reduction in static head at the blowout zone. This factor is particularly dangerous in causing well blowouts because its occurrence is not predictable and is quite often rapid. Twelve of the blowouts, or 22 percent, resulted from a loss of fluid into exposed formations.

This cause of primary control failure may be further resolved into natural lost circulation; and induced lost circulation by (1) running-in pressure, (2) excessive fluid density, and (3) type of fluid.

Natural lost circulation is the quality of the formations which results in loss of normal density drilling fluid into fissures, cavities, highly permeable sands and gravel beds, and semi-depleted productive zones. This loss may occur at a depth above or below the blowout zone during drilling or after a necessary increase in drilling fluid density has been made to maintain control over the formation pressure in the potential blowout zone. Seven of the blowouts, or 13 percent, occurred during actual drilling as a result of this lost circulation.

Induced lost circulation occurs when a pressure considerably in excess of that required to prevent the inflow of formation fluid is imposed on the walls of the hole and causes loss of circulating fluid with a drop in fluid level. The increase in pressure which induces this type of lost circulation may result from the following:

1. *Running-in pressure* is defined as the increase in pressure throughout the column of drilling fluid as a result of running in drill pipe, casing or various drilling tools. The proof of the existence and an approximation of the magnitude of running-in pressures may be obtained by reviewing a study by G. E. Cannon[2] on the relationship of drilling fluid gel strength to pressure reduction by the withdrawal of drill pipe. In this paper, the effect of gel strength was determined "by withdrawing 90 feet of drill pipe and lowering it immediately to its original position." A review of Cannon's Figure 3 indicates a pressure increase over the static pressure during the return of the pipe to its original position.

Since field experimental evidence has been obtained by Cannon on the relationship of gel strength to presure drop during the withdrawal of pipe, it seems reasonable to assume that there is a corresponding pressure increase during the running of pipe. Two of the blowouts, or 4 percent, resulted from a drop in fluid level from lost circulation caused by this running-in pressure.

2. *Excessive fluid density* is used frequently in exploratory drilling in anticipation of encountering high pressure zones or after observing some contamination of the circulating fluid by gas, oil, or salt water entry. Infrequently, an interval above or below the blowout zone will weaken under the excessive bore hole pressure, causing a loss of head and increasing the danger of a blowout. Cement slurry in casing cementing operations has often induced loss of fluid because of its high density (110-120 pounds per cubic foot) during displacement of lower density mud. This fluid loss may occur in formations which have not shown a tendency toward this trouble during the drilling of the hole. The cause of 3 of the blowouts, or 5 percent, can be attributed directly to this phase of cementing operations.

3. *Type of fluid* plays an interesting part in the loss of fluid from the bore hole. There are 3 blowouts in which this factor contributed to the static pressure decreases resulting in the blowouts. In semi-depleted oil zones with associated fingers of lenticular or locally fault-sealed gas sands, a low density drilling fluid may be used satisfactorily for drilling into the zone and controlling the formation pressure of the previously undepleted gas sands. Upon completion, however, the circulating fluid is often changed to oil or chemically treated water for wall scraping or for perforation washing. These fluids do not form satisfactory wall cakes, and during static periods they tend to flow into the permeable low pressure portions of the exposed zone. The resulting decrease in static head by this drop in fluid level may contribute significantly to the cause

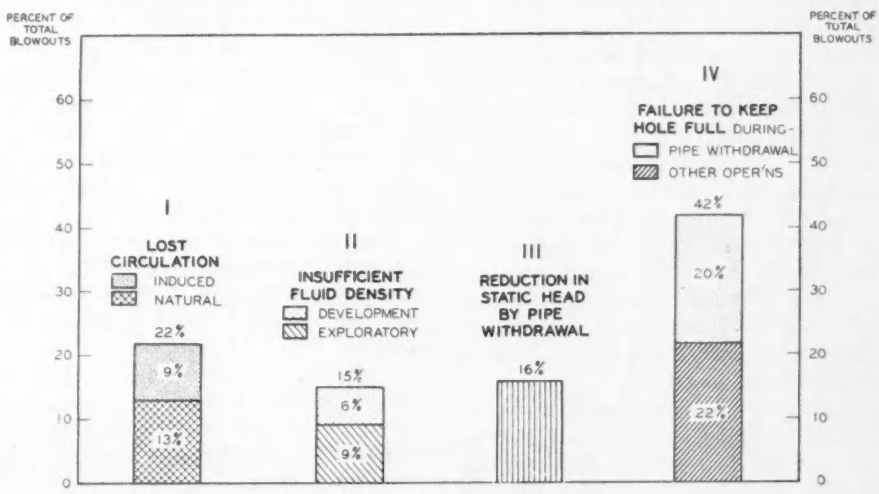


FIGURE 3. Causes of well blowouts through failure of primary control.

TABLE 3

Well Blowouts In California Drilling Operations
Loss of Primary Control Over Formation Pressure

CAUSES:	PRINCIPAL CAUSE		CONTRIBUTING CAUSE	
	Number of Blowouts*	Percent of Total Blowouts	Number of Blowouts	Percent of Total Blowouts
I. Lost Circulation	12	22%	8	15%
A. Natural	7	13%	5	9%
B. Induced	5	9%	3	6%
II. Insufficient Fluid Density	8	15%	....	....
A. Development Conditions	3	6%	....	....
B. Exploratory Conditions	5	9%	....	....
III. Reduction in Static Pressure by Pipe Withdrawal	9	16%	7	13%
IV. Failure to Keep Hole Full	23	42%	3	6%
A. During Pipe Withdrawal	11	20%	3	6%
B. During Other Operations	12	22%	0	0
TOTAL	52*	95%		

* Principal cause of primary loss of control for one blowout was inadequate surface fittings (see Part III.). Principal cause could not be determined for two blowouts of the 55 investigated.

of a blowout from previously undrained sands within the productive zone.

Insufficient Drilling Fluid Density

The most obvious cause of the loss of primary control over formation pressure is insufficient drilling fluid density. This review of well blowouts reveals that this factor was the principal cause for eight blowouts, or about 15 percent of those studied. It was not considered to be a contributing cause in any of the blowouts, since it is easily seen that a sufficiently high drilling fluid density would permit considerable latitude in other causes of the loss of primary control without a blowout occurring.

This factor has been further divided into Development Operations and Exploratory Operations.

In *development operations,* information should be available from previous drilling in the field to provide a reasonable basis for estimating the formation pressure of the various permeable sands to be penetrated. When insufficient density of the drilling fluid is the principal cause of a blowout under these conditions, it is the result of inadequate consideration of formation characteristics prior to drilling and during completion operations. There was only one blowout from this cause in development wells during actual drilling. However, it was possible in several cases that some gas cutting of the mud had taken place during drilling which may have contributed to lowering the effective head by a reduction in fluid density. This reduction, in turn, may have contributed to well blowouts resulting principally from other causes. Three of the blowouts, or 5 percent, resulted from insufficient fluid density in development operations.

In *exploratory operations,* it was found that 5 blowouts, or 9 percent of those studied, were caused by insufficient fluid density, 4 of them occurring while drilling was in progress. The number of blowouts is higher for exploratory drilling than for development drilling since the formation pressure characteristics are usually not known in exploratory operations. When an abnormally high formation pressure gradient is combined with lost circulation zones in the same open hole, it is obvious that considerable trouble can, and does, result in attempting to control potential blowout zones with the drilling fluid.

It is well recognized in field operations that severe gas cutting of the drilling fluid will reduce the effective static pressure at the potential blowout zone. This gas cutting may occur from (a) drilling into a sand with insufficient drilling fluid density to exceed the formation pressure or (b) contamination of drilling fluid by the gas present in the drilled-up section of the hole, even though the fluid density may adequately exceed the formation pressure.

The gas cutting caused by use of insufficient fluid density can be eliminated only by increasing the density to safely exceed the formation pressure. The contamination resulting from gas in the drilled-up section is supposedly minimized by drilling a gas sand slowly, or at a rate considerably less than that obtainable. In order to determine the significance of pressure reduction by gas cutting during drilling, it was assumed that a typical California gas sand was penetrated with a drilling rate of 60 feet per hour, a circulation rate of 25 cubic feet per minute, and a fluid density of 75 pounds per cubic foot. Neglecting temperature change and gas compressibility, it can be calculated that the penetration of this sand under these conditions may result in a pressure reduction at 5000 feet of approximately 90 psi. At more normal rates of 30 feet per hour for penetration and 50 cubic feet per minute for circulation, some reduction in bottom hole pressure will be obtained by gas contamination from the drilled-up section of the hole but the amount is negligible in comparison to the usual pressure excess of the fluid column. It may be concluded, then, that except at high drilling rates (above 60 feet per hour) there is no appreciable benefit to be gained by the slow penetration of gas sands, provided a normal pressure excess is being maintained by the drilling fluid column.

Naturally, the mud density reduction by gas contamination from the drilled-up section may be hazardous when (a) the mud column pressure is only slightly greater than the formation pressure, (b) the gas contaminated fluid is recirculated without surface conditioning, or (c) a shallow high pressure gas sand is exposed during gas contamination of the fluid from drilling in a deeper sand.

Reduction in Static Pressure by Pipe Withdrawal

The conclusion was inescapable in this review that the only possible reason for the loss of primary control in some cases has been a reduction in static head during pipe withdrawal by some means not related to the fluid level or density. Well histories have been studied where positive pressure differentials of 70 psi to 350 psi existed over the formation pressure and satisfactory drilling progress was made. Yet, upon pulling the pipe upward to withdraw it from the hole or to retrieve a wireline core barrel, a blowout has occurred within a short time. Nine of the well blowouts, or 16 percent, resulted from this reduction in static pressure by pipe withdrawal.

Static pressure reduction by pipe withdrawal has been observed by several investigators.[3,6,7] Cannon[3] and coworkers conducted field tests to determine the magnitude of this effect and found that it depends on the length of pipe in the hole, the size of the annulus, and the gel strength of the drilling fluid.

The measurement of the gel strength of the mud was arbitrary at the time Cannon's work was published (1934), as it still is today. It seems reasonable to assume, however, that all values of gel strength arbitrarily measured in Cannon's work may be repeated in field fluids. Therefore, we may estimate the degree of pressure reduction on the basis of these actual field measurements. For example, from Cannon's Figure 4, it was found that the withdrawal of 3½-inch drill pipe from 5000 feet in 7-inch casing with a low gel strength fluid resulted in pressure reductions up to 250 psi. Then, even if low values of gel strength as measured by Cannon are accepted as representative of California field conditions, it appears possible to obtain an appreciable static pressure reduction by pipe withdrawal.

Static pressure reduction as a cause in well blowouts was found to be especially critical following cementing operations. After plugging with cement or drilling out cement, the drilling fluid usually has a high gel strength, even when the fluid is chemically treated for viscosity reduction. As a result of this high gel strength, pipe withdrawal during such a period will produce a large pressure reduction. If the drilling fluid density does not provide sufficient pressure excess, then the pressure may be lowered sufficiently to cause a well blowout.

In this study, it was difficult to determine accurately the proportion of well blowouts resulting from pressure reduction by pipe withdrawal because of the lack of basic data on gel strength measurements. Many cases were associated with failure to keep the hole full. However, in cases of probable high gel strength from cement contamination and in cases where only a small amount of drill pipe had been withdrawn, it was assumed that the principal cause of these blowouts was pressure reduction by pipe withdrawal.

Failure to Keep Hole Full of Fluid

The effect of failure to keep the hole full of drilling fluid is, of course, the same as that observed with lost circulation, i.e. a lowering of the fluid level with consequent reduction in static head. It is a distinctly separate action from that of lost circulation, however, since it can be controlled at the surface. There is no valid excuse in drilling operations for this cause of well blowouts. Twenty-three blowouts of those

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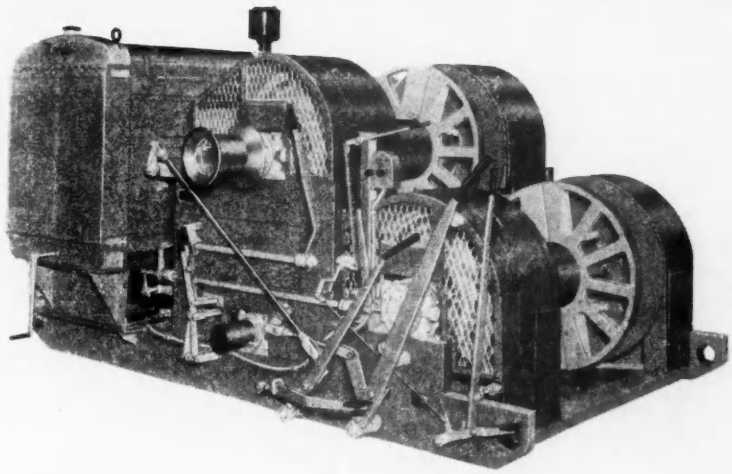

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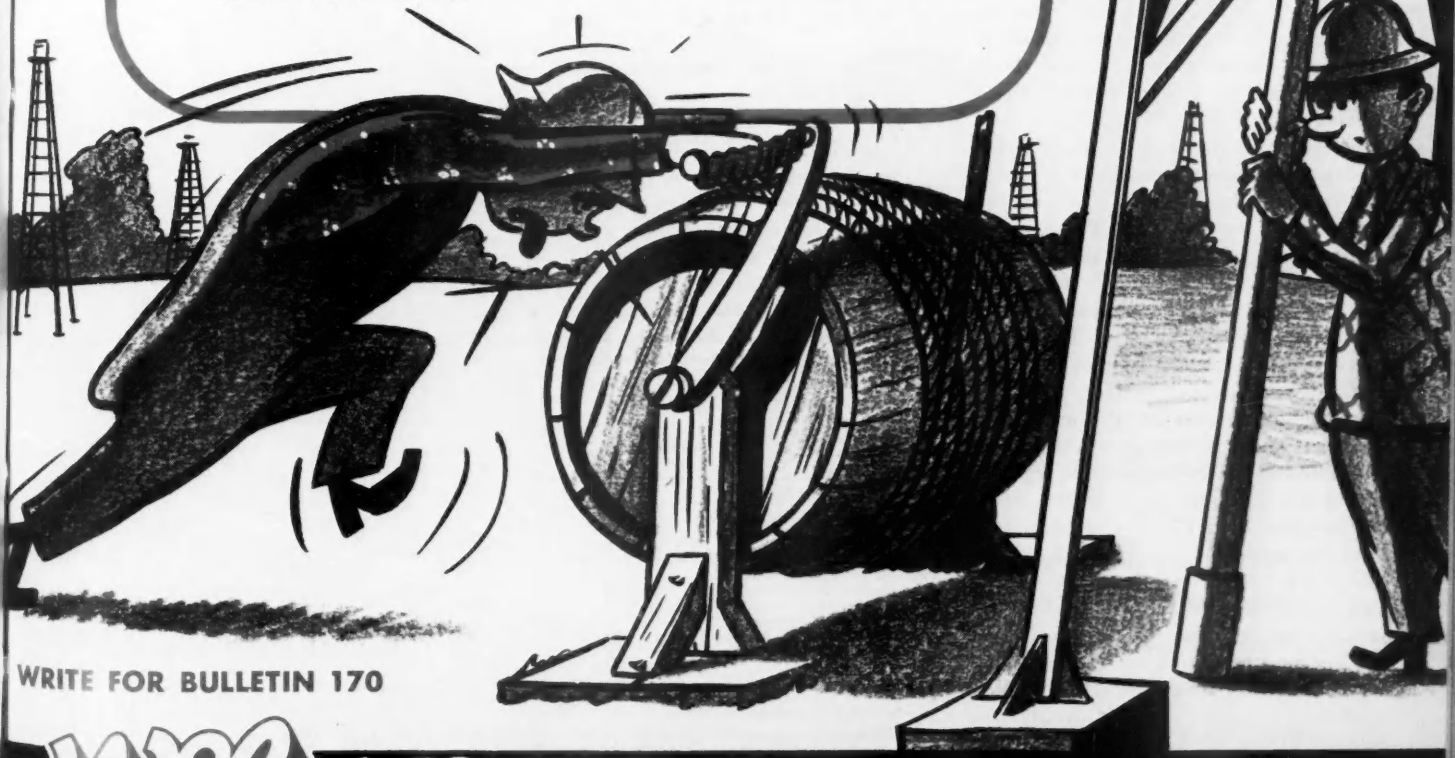

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studied, or 42 percent, were caused by failure to keep the hole full.

It is usually found that this factor is of considerable importance in operations where (a) the drilling fluid density provides only a small pressure excess over the formation pressure with a full column, or (b) a formation or water shut-off test has been made and a long column of closed drill pipe is being withdrawn from the hole.

This cause of blowouts has been divided further into those occurring during pipe withdrawal and during other operations.

An approximation of the magnitude of the pressure reduction resulting from not filling the hole *during pipe withdrawal* may be easily calculated. For example, in pulling 3½-inch drill pipe with an unplugged bit from a 6-inch hole filled with 80 pounds per cubic foot mud, there is a pressure reduction of about 7 psi for each stand (90 feet long) withdrawn. Poor field practice usually involves filling the hole after pulling 5 to 10 stands, thus resulting in a pressure reduction throughout the column of 35 to 70 psi with open drill pipe. Most dangerous of all is the pulling of a plugged bit or a formation tester packer under these same conditions. In such a case a pressure reduction of 17 psi per stand is obtained and, if the same hole-filling practice is followed, a pressure reduction throughout the column of 85 to 170 psi results! Eleven of the blowouts, or 20 percent, were a direct result of not filling the hole during pipe withdrawal.

During other operations, a factor often overlooked is the slow drop in fluid level during suspension of drilling for equipment repair or for economic reasons. With exposure of an appreciable amount of permeable formations to the bore hole, gradual loss of fluid and establishment of filtration equilibrium can lead to a significant decrease in static pressure at the blowout zone. During equipment repairs on a recent well in the Ventura area, for example, it was found necessary to add drilling fluid to 7000 feet of open hole continually for more than 3 weeks at rates decreasing from an initial 90 barrels per day. This addition was necessary in order to maintain the fluid level at the surface, although no circulation loss during drilling operations had been previously noted. Six of the blowouts, or 11 percent, were a result of not keeping the hole full while a slow loss of fluid to the formation was occurring.

Gun perforating of casing during completion or plug-back operations without maintaining the hole full of fluid resulted in 3 well blowouts. The cutting of casing with a subsequent drop in fluid level and exposure of a blowout zone without filling the hole was responsible for 2 blowouts.

In summary, twelve of the blowouts, or 22 percent, were caused by not keeping the hole full during operations other than pipe withdrawn. All of these blowouts were avoidable if fluid had been continuously circulated into the hole.

Loss of Secondary Control Over Formation Fluid Pressure

The absence or failure of secondary control methods cannot be considered principally responsible for a well blowout, since a failure of primary control by the drilling fluid usually must occur before secondary methods are applicable. However, the success of using surface equipment for shutting in a well is dependent upon adequacy of equipment, proper maintenance, and installation of suitable auxiliary fittings. For the proper functioning of this surface equipment the flow must be confined to the casing. When the fluid flow bypasses the casing and breaks to the surface at points outside the well head, then any amount or kind of blowout equipment will not avail to control this flow. The causes of loss of secondary control over formation pressure are as follows:

1. Insufficient blowout control equipment.
2. Improper design or fabrication of blowout control equipment.
3. Improper installation of blowout control equipment.
4. Improper surface fittings for blowout control equipment.
5. Improper well casing program and cementing practice.

The percentages of well blowouts continuing out of control because of failure of these secondary control measures are indicated in Figure 4 and Table 4.

Insufficient Blowout Control Equipment

The drilling of a well in hazardous territory without adequate blowout control equipment is poor drilling practice and is not recommended. In 16 of the blowouts, or 29 percent, efforts for shutting in the well were hampered by (a) complete absence of surface equipment, (b) pipe pack-off equipment only with drill pipe out of the hole, or (c) complete shut-off gate only with drill pipe in the hole.

TABLE 4

Well Blowouts in California Drilling Operations Loss of Secondary Control Over Formation Pressure

CAUSES	Number of Blowouts*	Percent of Total Blowouts†
Insufficient Blowout Control Equipment	16	29
Improper Design or Manufacture of Blowout Control Equipment	3	5
Improper Installation of Blowout Control Equipment	6	11
Improper Surface Fittings for Blowout Control Equipment†	3	6
Improper Well Casing Program and Cementing Practice	6	11
	34	62

* Blowout control equipment worked satisfactorily or was not required in 20 well blowouts, 36 percent of those studied.

† Directly responsible for one blowout.

Improper Design or Fabrication of Blowout Control Equipment

This factor involved a mechanical failure of the surface equipment because of poor design or construction. The 3 blowouts which continued out of control because of this type of failure took place prior to 1945, as considerable improvement has been made in this equipment during the past 5 years.

Improper Installation of Blowout Control Equipment

In approximately 6 of the well blowouts, or 11 percent, secondary control could not be established because of the use of wrong equipment or parts for the actual or anticipated conditions. Installation of the wrong size drill pipe rams, use of equipment not designed to withstand the anticipated pressures, failure to incorporate design changes recommended by the manufacturer, and lack of knowledge of the procedure for use were responsible factors in the 6 blowouts.

Improper Surface Fittings for Blowout Control Equipment

One blowout of those studied was directly attributable to improper surface fittings. In addition, the use of landing spools, pipe connections, and other fittings which were not able to withstand the maximum pressure exerted on the well head during a blowout have been responsible for lack of secondary control in three of the blowouts.

Improper Well Casing Program and Cementing Practice

In 6 of the well blowouts, or 11 percent, the formation fluid by-passed the casing, causing serious damage and considerable expense. This by-passing resulted from insufficient surface casing, casing failure or an ineffective cement bond.

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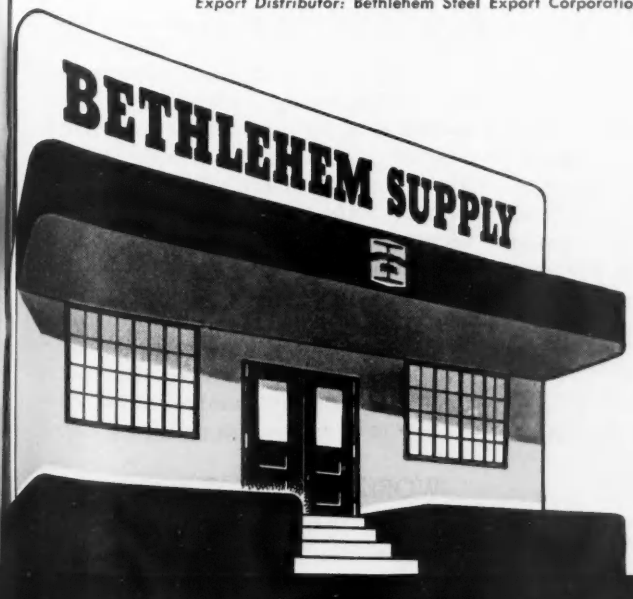

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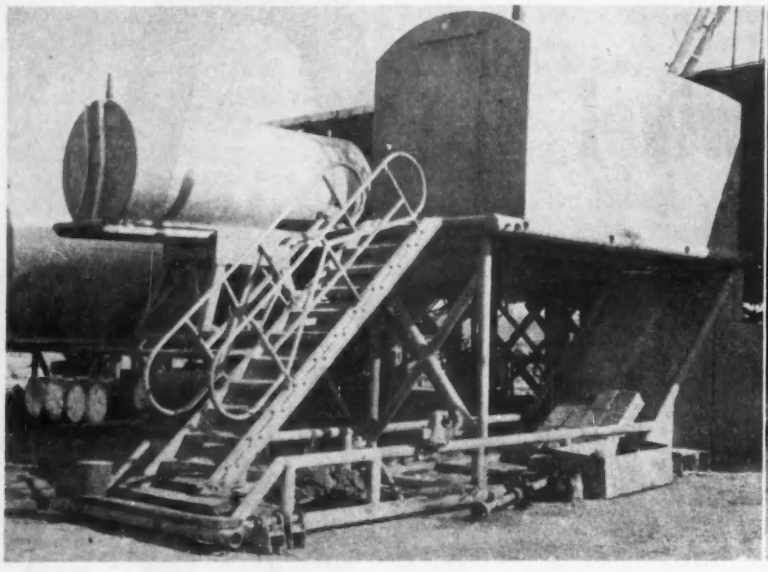


FIGURE 1. Principal advantage of this combination dog house and materials rack is that the house can be lowered, in a horizontal position, with the aid of only a winch, to where it rests atop a two-foot high rack. It is hauled as a single, low center of gravity unit and is as easily re-erected at the next location.

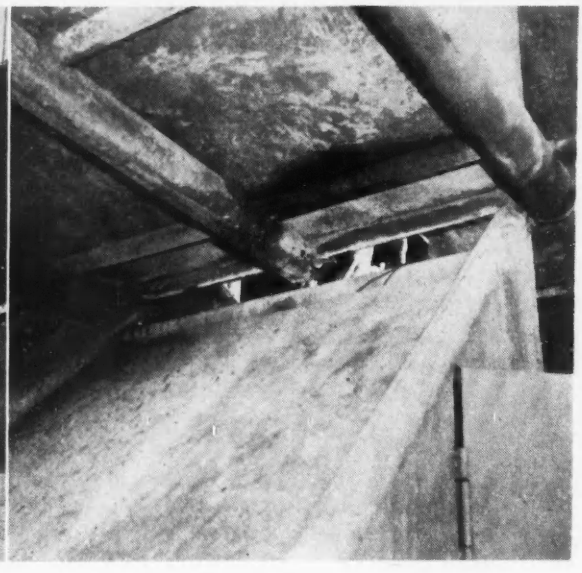


FIGURE 2. View showing under side of dog house at point where it rests atop the enclosed tool house. Note that, when raised or lowered, the dog house skids along on the 45-degree sloping side members of the tool house structure.

Dog House Mounted on Collapsible Rack

By GILBERT M. WILSON
Pacific Coast District Editor

MOUNTING the dog house on an elevated structure so the floor of that unit is level with the derrick floor is a common practice among drilling contractors. In most instances, the supporting structure, which serves also as a carry-all rack for miscellaneous pipe fittings and supplies, and the dog house are two separate pieces and are hauled and installed separately. One drilling contractor operating in the West Texas area has devised an unusual method of constructing dog house units. Instead of making them up as separate units, he combines the dog house with the supporting structure, at the same time incorporating a feature which enables him to lower the dog house to near ground level with the aid of only a winch-equipped truck and without having to detach the two units. After it has been lowered, the combination dog house and rack then is hauled as a complete unit and is as easily re-erected at the next well. The design of the unit is such that storage space in the bottom of the rack is retained. Also built into the supporting structure, at the rig end of the rack, is an enclosed steel tool house or storage room.

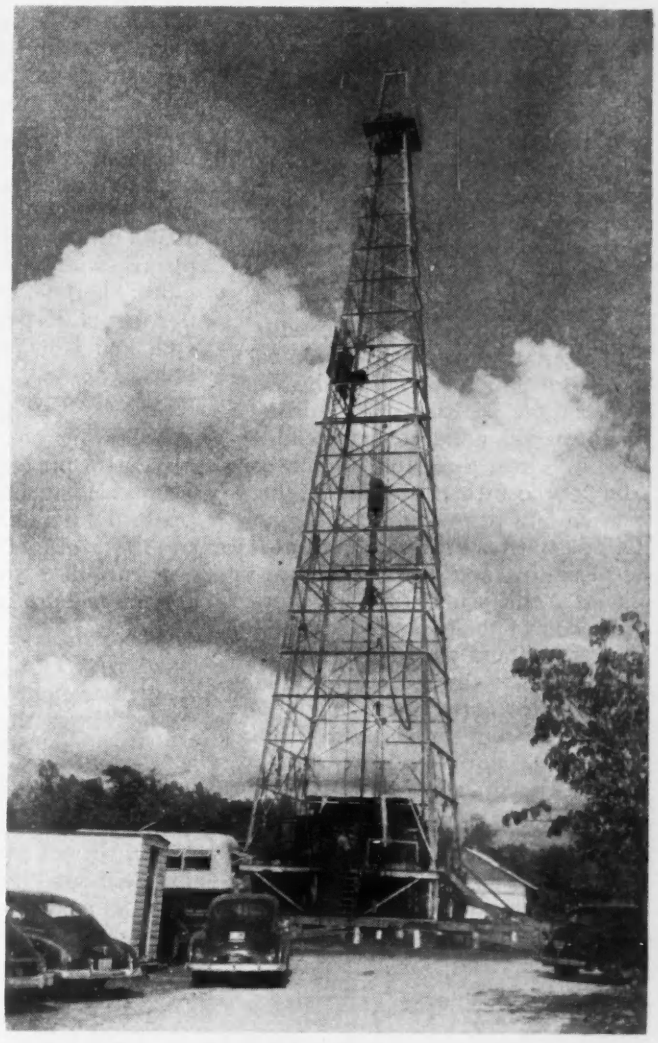
The principal feature of the combination unit is the manner in which the dog house can be raised and lowered. Referring to Figure 1, it is seen that the rig end of the house rests upon the top of the triangular-shaped tool house, the "roof" of which slopes at a 45-degree angle. The other end of the dog house rests upon an X-braced upright rectangular structure, which is attached by horizontal pins to both the base of the rack at ground level and the under side of the dog house platform.

House Lowered in Horizontal Position

To lower the dog house from the elevated position shown, the entire assembly is skidded away from the rig a short distance, a winch-equipped truck is backed up to the rig end of the structure and the winch line then is hooked into a steel loop welded to the front end of the dog house platform. After locking pins are removed from that end of the platform, the dog house base is barred over the peak of the supporting structure and the winch line is slowly fed out as the house skids down the inclined ramp. Wear on the ramp is taken up by two lengths of drill pipe which form the sides of the 45-degree incline. As the dog house descends, the X-braced support at the other end falls forward allowing the house to remain in a horizontal position throughout its descent and until it rests upon the two-foot high guard railing running along the sides of the ground-level storage rack. The house and structure are erected in the same manner, the truck

• CONTINUED ON PAGE 110

Records Broken *by* Independent Wildcat



There is nothing about the rig and surroundings to mark this as the deepest test east of the Mississippi, and only the string-up hints of more than a routine drilling operation. The laboratory at left makes field tests on each foot of core as retrieved, and provides current geological data for the operator.

DEEP WELLS hold geological interest whenever they penetrate horizons as yet untested in the area, and generally testify to technique perfection in reaching depths in three-mile figures. This article briefs the operations which have carried this independent wildcat far below any other test east of the Mississippi and to a present ranking of third deepest in the country. Oil-base mud and diamond bits enable the well to be cored continuously, and to make the round trips without delay for reconditioning hole.

By ELTON STERRETT
Engineering Editor

THE deepest well east of the Mississippi River, the third deepest in the U. S., and still drilling, is George Vasen's Tung Oil Corporation 1, two miles from the town limits of Wiggins, Stone County, Mississippi. It is likewise noteworthy as being the deepest test ever drilled by an independent operator and for use of diamonds bits and oil-base mud at great depths.

The well history dates back to 1946 when, originally started as Tom McKinney's Tung Oil Corporation 1, it was taken over by the present operator and spudded as a projected test to 10,200 feet or the Paluxy. This formation was eventually logged at 10,475 feet below the rotary table, or 10,231 subsea, with surface elevation given as 244 feet. Drilling was carried on this initial program to 11,209 feet without show or production, and the project was temporarily abandoned after running electric log.

When the project was again revived the task of cleaning hole after the long inactive period was an arduous process, as the hole was uncased except for the surface string. Drilling was finally resumed and the long open hole was carried to a total depth of 14,038 feet, where seven-inch casing was cemented to within six feet of bottom.

Resumption of drilling below the casing string saw the hole carried to 14,411 feet, at which depth a lost bit, core barrel, and 120 feet of pipe required a side-tracking operation. Following a successful whipstocking job, drilling was resumed and carried to 14,450 feet. From that point on all drilling has been done with a 5⅞-inch diamond bit, taking a 3 1/16-inch core. Continuous coring has been the program from the depth stated to the present mark (as of Sept. 16, 1950) of 18,370 feet. There has been but one fishing job, that resulting from parts lost off broken equipment as an attempt was made to survey the hole.

Equipment on this wildcat is lighter than usually expected for holes in the depth range attained. The well has a 136-foot derrick, three oil-fired oil field "pots" each of nominal 150 boiler horsepower, two mud pumps, and drawworks more than ten years old. Wire line is 1⅛ inches, which,

with the 2⅞-inch drill pipe used, involves a pull-through and cut program after each fourth round trip.

Coring Procedure

With the capacity of the core barrel being approximately 30 feet, a standard core length of 27 feet was adopted, with the drill string being pulled for core recovery each time this amount of footage had been logged. Practically 100 percent cores recovery has been the rule, with a field laboratory running tests on each foot of formation cored. For this work a special core-cutting unit, utilizing a miniature diamond cutting head, removes a clean three-fourth-inch core from the central axis of the three-inch core as recovered from the hole. This sample core is tested for porosity, permeability, and possible oil-bearing shows at the same time that other fragments of the core are checked for lithography and paleontological data. In addition to the thorough checking of the cores at the field truck, core samples are sent to the central laboratory of the core servicing company for additional testing.

Mud Program

The original drilling program for the well called for water-base mud, this fluid also being used for the first diamond-coring schedule. It was found that the time to recondition the mud in the bottom of the hole — with a temperature of 320° F or more —required from 12 to 16 hours before the mud was in shape to permit resumption of actual drilling. At a total depth of 14,670 feet, on January 21, 1950, the water-base mud was displaced with an oil-base pre-mixed mud. The hole then consisted of 14,032 feet of 35-pound casing protected wall and 638 feet of 5⅞-inch open hole. The bulk requirement of the mud system was then 685 barrels.

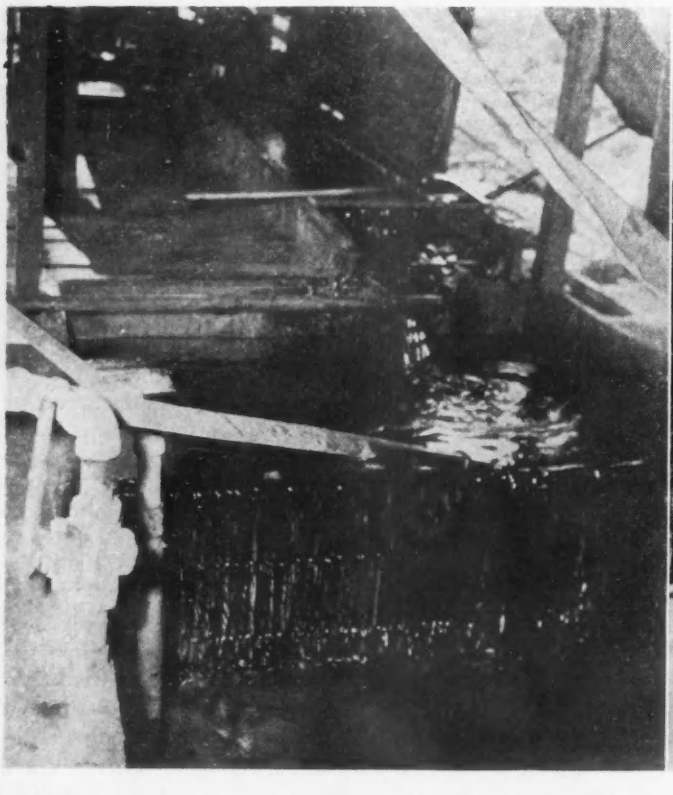
Following completion of the displacement process, weighting material was added to bring the mud weight up to 8.8 pounds per gallon. A total of 350 sacks of weighting material was mixed in to meet requirements for the amount of mud involved.

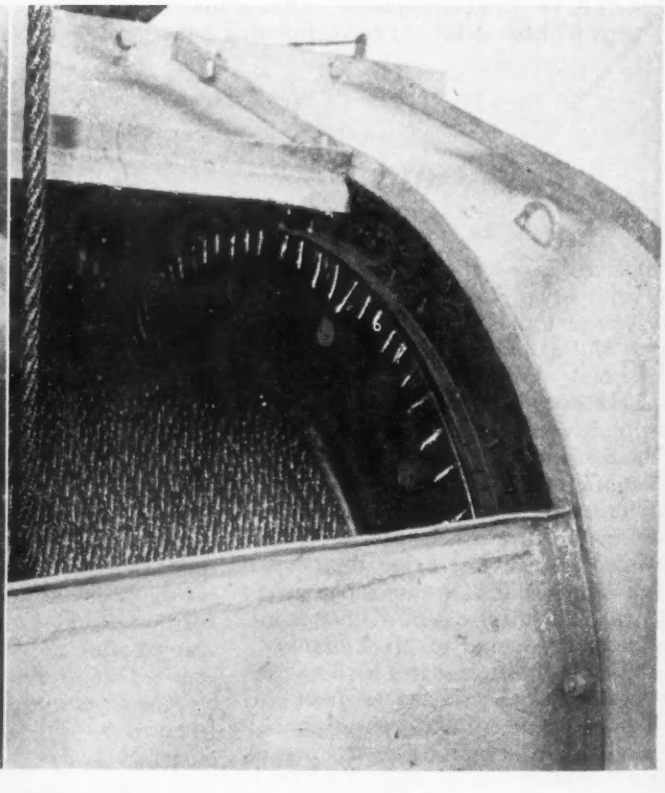
The coring program previously outlined was followed with the change in drilling fluid, and up to the latest report no rig time had been charged to mud conditioning. When making a round trip it is customary to come out of the hole without previously conditioning the mud, and to put the bit on bottom again and resume drilling without conditioning or loss of time. The only weight material added is a few sacks to slug the pipe before making a trip. Not only was it unnecessary to recondition the hole after round trips, but it was also found that drilling could be resumed after leaving the bit on bottom for periods of from a few minutes to several hours without trouble from mud viscosity change or settling out of the cuttings. These periods of bit idleness occurred when pump repairs were required, or when it was necessary to take one or more of the battery of boilers out of service for workover.

19 Cores Cut

Nineteen cores were cut during the first 31 days of the coring program. In the next 52 days, as an example of the stability of the mud program, 32 additional cures were cut without shutdown or delay from mud troubles.

The oil-base mud, constantly checked by a mud engineer, has been found to remain essentially stable, regardless of the relatively high percentage of solids from diamond bit cuttings which, from the nature of the bit operation, tend to be minute and thus more readily carried in suspension in the drilling fluid. Water content of the fluid was checked at 14





LEFT: The mud system is relatively simple. A short flume, a baffle for removing most of the cuttings that are fine enough to pass the screen, and a sump section of the suction pit handle the covered circuit to the pumps.

RIGHT: To enable him to watch the slow feedoff of the drilling line and assist in maintaining correct weight on the diamond bit, the driller marks off the periphery of the drum flange with chalk. It is relatively easy to watch the slow progress of each mark toward the reel shield, and thus to evaluate the progress of the bit.

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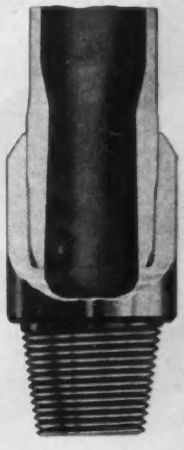

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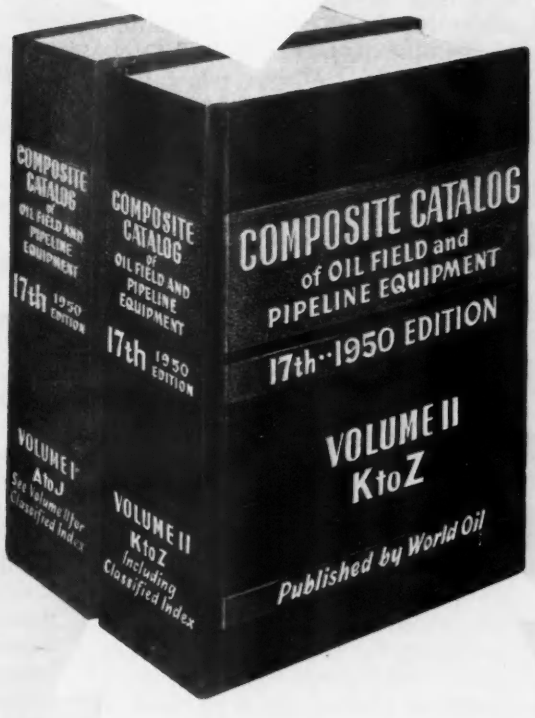
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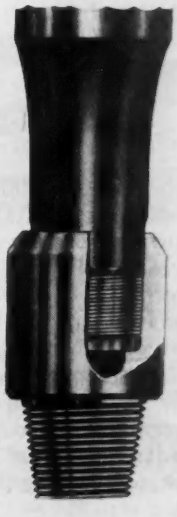

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percent following a season of heavy rains and high winds, which probably accounted for surface contamination of the mud in the ditch and pit, although both of these were roofed over and surface flow diverted.

Three drums of special treating chemical (for water removal) and 120 barrels of diesel oil were added to the ditch during the 83-day check period to maintain the desired mud viscosity.

Mud viscosity, API Marsh funnel, has ranged from 80 to 210 seconds, being predominantly in the range from 90 to 130 seconds, with an over-all average of 121.2 seconds. Figures are determined from hourly checks throughout the drilling time on each core.

Addition of a few sacks of weighting material for slugging the pipe before each round trip (approximately 300 sacks were used during the 83-day period mentioned) brought about a gradual weight increase from the initial 8.8 pounds per gallon to a figure slightly in excess of ten pounds. The over-all average was in the range of 9.5 pounds per gallon.

Bottom-hole Temperature

In the interval between 12,500 and 13,000 feet a temperature of 317° F was recorded, with the present bottom-hole temperature being estimated at 320 degrees or higher. No successful thermometer run has been made since inception of the latest coring run. Flowline temperature remains consistently in the range of 110 to 112° F, regardless of outside thermometer readings. Filter tests show zero fluid loss, with a cake thickness of 1/64-inch.

Fishing Jobs

Following the unsuccessful fishing job at the time the bit and 120 feet of pipe were left in the hole, there has been no trouble chargeable to sticking of the pipe or to crooked hole. The only fishing job since the whipstocking occurred early in May, when an attempt was made to check formation conditions at the bottom of the hole and the survey instrument hung up in the hole. When attempting to free the unit it parted, allowing the lower end to fall to the bottom of the hole. Fishing succeeded in recovering all of the missing parts but two halves of a split sleeve, approximately three inches in length and with an inside diameter of 1½ inches. These two steel parts could not be picked up by the junk basket, and were finally supposed to be sidetracked somewhere up the hole. The bit was again put on bottom, and drilling resumed.

An unusual fish. These two halves of a split collar were milled to their present form by the cutter at a depth of more than 14,700 feet without damage to the cutting points. The two halves were retrieved atop the next core—a standard 27-foot unit—and the bit subsequently used for several additional cores before being replaced.

With recovery of the next core the missing parts were located. They had evidently lain parallel at the bottom of the hole, and been moved to the center by the core bit. While there the diamond cutting points had milled off metal until the two halves, now trimmed to fit within the bit, formed the top of the core. Recovered at the next round trip, condition of the two steel sections called for close examination of the diamond cutting head. As no evidence of damage to the diamonds was found, the bit was again run into the hole, where it continued to cut hole and core true to gauge.

Although the well has not yet shown promise of being a producer, it is yielding invaluable geological data, as shown in Table 1, which indicates that the thickness of the Smackover lime may carry vast stores of oil in the area, once porosity and permeability factors permit. As yet, no definite depth has been set, and coring—and deepening—of the well is expected to continue until all available information has been secured.

TABLE 1
Geological Markers

Depth*	Formation (topped)
2616	Wilcox
4910	Midway
5736	Clayton
5790	Selma
6960	Eutaw
7020	Eagle Ford (?)
7576	Tuscaloosa
8316	Massive
8504	Lower Cretaceous
9669	First Lime
10,475	Paluxy (sand)
12,595	Glen Rose
(Not released)	Buckner (lime)
17,100**	Smackover (lime)
18,250	Same—Total Depth (Sept. 8, 1950)

* All depths from 244-foot elevation above sea level.
** Approximate, only.

Dog House Mounted On Collapsible Rack

■ CONTINUED FROM PAGE 106

winch being used to elevate the house and following which the assembly is skidded over close to the derrick floor.

The supporting structure is made almost entirely of salvaged 4½-inch drill pipe material. The rack measures 7 feet wide by 25 feet long. The X-braced support is 9½ feet high by slightly more than five feet wide, its width being such that the two uprights fall just inside the two-foot high pipe railings of the materials rack. For greater stability, each of the two outer members of the skid base consist of two lengths of drill pipe welded together side by side. The materials rack, in which is stored such items as miscellaneous pipe fittings, valves, bits and general supplies, is floored with sheet steel.

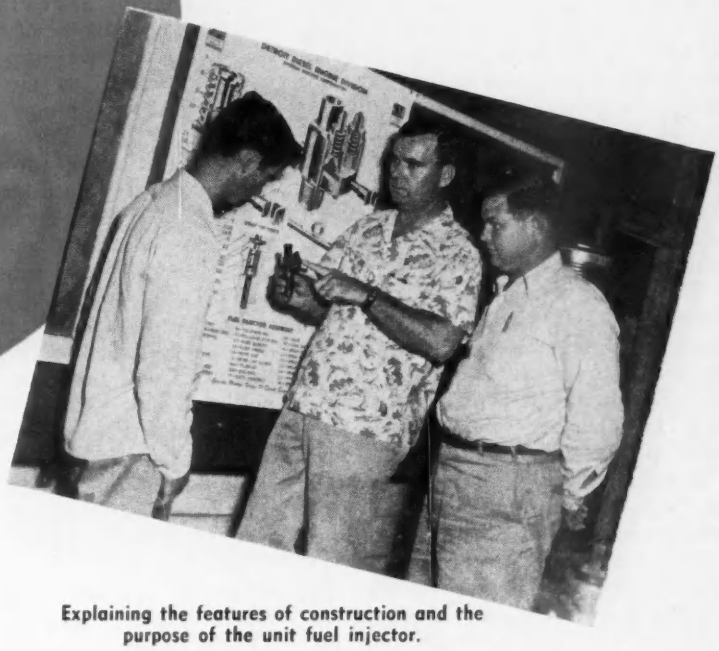
The dog house, approximately 14 feet long, rests upon a slightly longer platform made of three longitudinal pieces of 6⅝-inch casing, strengthened by laterals of three-inch tubing. This construction, and the manner in which the platform rests atop the peak of the tool house, is illustrated in Figure 2. At several points along the sides of the dog house platform openings are provided into which short pieces of two-inch pipe can be inserted to support a walkway whenever desired.

Several important advantages realized through the use of this easily-rigged, compact type of installation are that (1) time for rigging-up and tearing down is materially reduced; (2) the entire unit can be carried as a single, low center of gravity load, thus saving on hauling costs between locations; (3) by combining the tool house with the miscellaneous materials rack, fewer pieces of equipment must be handled, spotted and loaded separately; and (4) the ability to raise and lower the dog house in only a few minutes and with the aid of only a winch-equipped truck, reduces time on the job required of mobile cranes or other special loading equipment.

The fact that the dog house rests on its own base, which is positioned at the edge of the rig floor, eliminates any need for supporting the end of the dog house platform on the derrick floor where, particularly on the smaller jackknife type of rig, space is not plentiful. A welder can easily build the unit of used materials generally available in the yard. The only essential specification is that it be constructed to dimensions conforming with the height of the derrick floor of the rig on which it will be used.

Care of Diesel Drilling Engines

PRINCIPAL FACTORS affecting diesel operation are listed and recommendations made for proper care and servicing by the man in charge so that down time will be eliminated and service life between major overhauls extended. The author also advocates the placing of trained diesel technicians in charge of the rig's dieselized power plant.



Explaining the features of construction and the purpose of the unit fuel injector.

By JOHN A. BOATMAN
Division Maintenance Engineer
Rowan Drilling Company, Fort Worth

THIS is a sequel to an earlier article[1] on the care of gas drilling engines. It is intended for the engineman or motorman who is charged with the tour-to-tour care of drilling engines using diesel fuel.

In the earlier article, it was pointed out that the two types of engines are very similar in features of construction. The chief difference between a diesel engine and a gas engine lies in the type of fuel used and the manner in which the fuel is introduced into the combustion chamber. The gas engine operates on a compression volume ratio of about six to one, which precludes pre-ignition of the fuel. Hence, a sparkplug or other means of artificial ignition of the fuel is necessary. The full diesel engine operates on a compression volume ratio of about 16 to 1, which insures automatic ignition of the fuel. Air becomes hot when compressed. If air is compressed to a sufficient pressure, its temperature will rise to well beyond the burning point of fuel. This is the principle on which a diesel engine burns its fuel. For this reason, air and fuel are not mixed in a diesel engine during the intake and compression strokes. Pure air is drawn into the cylinder during the intake stroke of the piston and compressed to about 500 pounds per square inch. This results in a rise in temperature of the air to approximately 900° F. Near the end of the compression stroke of the piston, a measured amount of fuel is injected into the combustion chamber. Since the burning point of a good grade of fuel is about 680° F., it is easily understood why the fuel will ignite automatically when it is brought into contact with air at 900° F. temperature. The burning fuel inside the cylinder heats the air to an even greater temperature. Air expands when heated; and this force of expanding air against the piston results in the conversion of heat energy in the fuel to mechanical energy in the crankshaft. The connecting rod is used to convert the reciprocating motion of the piston into rotary motion of the crankshaft.

Wide use of diesel engines, as we know them today, has been developed mainly during the past decade. During the recent war all production went to the armed services or allied organizations. Since the war, however, commercial production has been so great that the industry is faced with an acute shortage of trained technicians. Diesel owners need more operators with technical training, which will insure early diagnosis of trouble symptoms and thereby contribute to lowered maintenance costs. Several accredited trade schools offer specialized training in diesel engines. The man who has operated such engines for years could greatly profit by this type of training. Several leading colleges and universities also offer this training in correspondence courses if on-the-job training is not possible. Several of the more progressive drilling contractors have found it feasible to pay the cost of this training for their regular employes.

Starting Methods

The most commonly used methods for starting diesels are air, gasoline engines, electrical starting motors and air starting motors. Many of the larger engines are started by the direct injection of high pressure air into the cylinders. Whenever this method is employed, cleanliness of the air is of prime concern as any moisture, dirt or rust finding its way into the engine

may lead to trouble. An air filter and dehydrator should be installed between the air bottles and the engines. As soon as the engine fires, the starting air valve should be closed immediately, as the presence of extra air in the cylinders will severely supercharge the engine and may lead to serious damage. Proper starting air pressure should be maintained at all times. Considering the human element involved, the best of drillers occasionally will stall all the engines. Stuck drill pipe may be the penalty for having to wait for starting air to be developed. The same caution should be applied to engines using gasoline starters. The gasoline tanks should be full at all times and the starting engine should be cranked at least once a week to check its dependability in an emergency. It should be possible at all times to start each main engine with its own starting device.

Electrical starting motors are found mostly on the smaller drilling engines; however, this method is employed on some of the larger units. Batteries should be kept fully charged as a partial charge will result in sulfated plates, which leads to a much shorter battery life. Cranking periods in excess of a minute are not recommended as the starting motor will overheat and the starter switch may become fused. It is wise to allow a cooling period of one to two minutes between cranking attempts. An engine will fire if it is in good mechanical condition and gets air and fuel. With this thought in mind, it is well to check for trouble should the engine fail to start from two or three attempts.

Before starting any engine, the operator should bar or jack the engine over two complete revolutions. (One complete revolution is sufficient for a two-stroke cycle engine.) This is to preclude the possibility of any mechanical obstruction or hydraulic lock due to water in the cylinders.

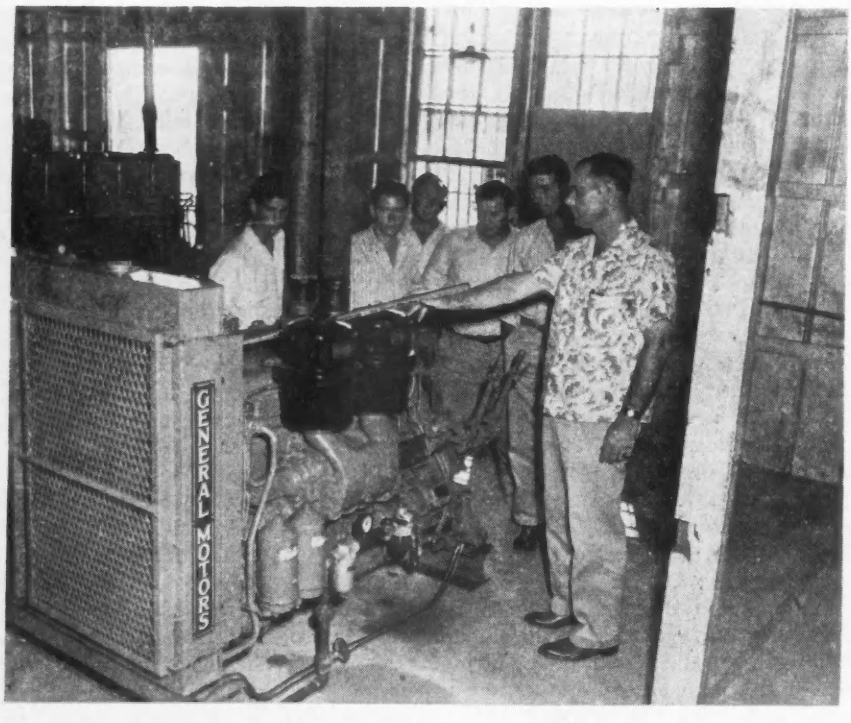
One of the most important points to consider in engine care is the warmup period after cranking a cold engine. The interval of time required for a proper warmup period will vary according to the size of the engine and the temperature of the surrounding air. Top of the engine will expand more rapidly than the base due to the centralized heat above the pistols. The connecting rods will be slightly deflected until the crankshaft has expanded into ratio to the top of the engine. At the beginning of the warmup period, the lubricating oil is viscous due to its low temperature. Oil will not lubricate properly and will not circulate through the filters until the engine temperature has reduced the viscosity of the oil.

Proper lubrication of a diesel engine has always been a serious problem. The extremely high pressures and high temperatures encountered in diesel engines contribute greatly to early deterioration of the oil. The chemistry of combustion in a diesel engine is different from that in a gas engine. Harmful acids are formed. Fuel dilution is more prevalent. Some operators check viscosity and acid content as the two foremost criteria of used lubricating oil. Lubricating oils of different viscosities should not be mixed. Light weight oil will not always blend with heavyweight oil to form a medium weight oil. Under no circumstances, except in extreme emergencies, should brands of oils be mixed. The chemical additives used and the process of refining will vary at different refineries and the mixing of different brands of oil may cause a breakdown in the properties of each individual product.

Efficient Cooling

Efficient cooling of the engine is vital for continued usage between overhauls. Only about one-third of the heat energy in the fuel is converted into useful power at the drive shaft. Another one-third is lost out the exhaust and the final one-third is lost through cooling. Water which contains mineral salts should be avoided if possible as these impurities cause excessive scale deposits in the water jackets and other parts of the cooling system. Scale is a poor conductor of heat. Concentrated heat spots caused by excessive scale often result in fractured cylinder heads, liners and jackets. If soft water is not available, the water should be treated. Pure water will result in more rapid rusting of ferrous metal engine parts than will scale-forming water. For this reason a rust inhibitor should be added to the coolant. Engines which have been under heavy load should be idled for several minutes before they are stopped. This is to remove the residual heat from near the combustion chambers. If a hot engine is stopped suddenly, the water adjacent to the combustion chambers will boil and form steam pockets. Heat transfer is impaired through these steam pockets and a fracture may result. Water jackets and other parts of the cooling system are sometimes attacked by electrolysis. To neutralize the electrolytic action of the coolant, zinc plates are used. This practice is seldom used in engines with the closed system employing radiators, but is found generally in engines on barge rigs or piling rigs where sea water is circulated through heat exchangers. Zinc electrodes should be inspected about once each month.

Keeping an engine clean means much more than attractiveness. Much of the engine heat is transferred directly from the exterior part of the engine to the atmosphere. Dirt and filth will impair this transfer of heat. A certain amount of the filth will



Pointing out the importance of synchronizing the speeds of both engines in a "twin" unit.

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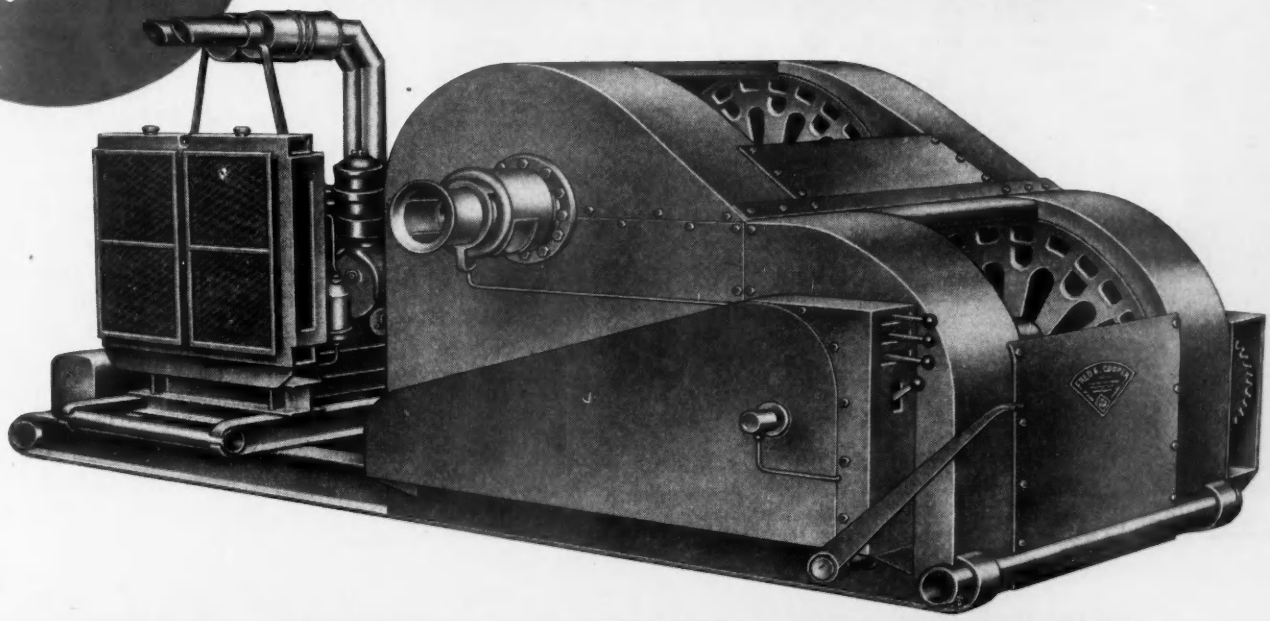

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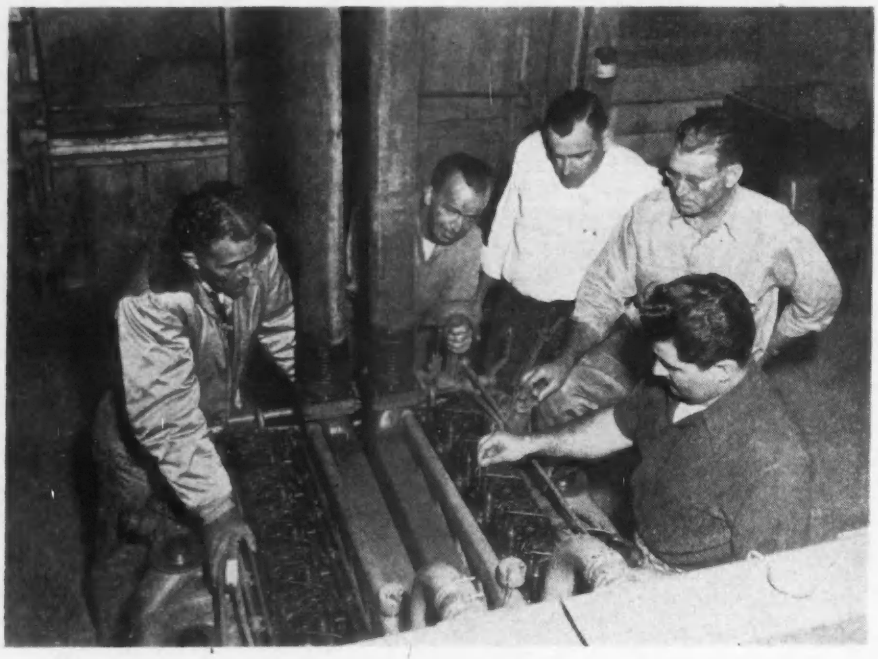

Demonstration of the balancing of cylinder loads by the timing of the unit fuel injectors in a "twin" unit.

find its way into the engine when inspection covers are removed. Leaks may be detected more readily on a clean engine. The operator who takes pride in maintaining clean engines will certainly receive due consideration from the owners when the time comes for a promotion.

The diesel engine operator who has a thorough knowledge of the principle of combustion will experience very little trouble-shooting. The basic fact should be kept in mind that if the engine is in good mechanical condition and it gets air and fuel, it will run. Fuel, or perhaps the lack of it, contributes to most of the trouble encountered in engine operation.

Cylinder temperatures are measured by an exhaust pyrometer. If all cylinders are receiving the same amount of fuel and the piston rings, liners and valves all contribute to good compression, then the temperatures of the gases leaving through the exhaust ports will be in good balance. The exhaust temperatures should not vary more than 25° F. between the hottest and coldest cylinders. As more load is applied to the engine, the governor moves the fuel racks to an increased fuel position. The increased fuel injection will raise the cylinder temperatures. At the same time, the increased load will tend to slow the engine down. The exhaust temperature should not exceed the engine speed by more than 100° F. If so, a black exhaust caused by overloading will be the result. Black exhaust will not indicate an overloaded engine in every case. If the engine load is normal, the smoky stack usually can be traced to a faulty fuel injector or spray tip. Faulty injection should be corrected at once because of the resulting unbalanced load on the crankshaft.

Analysis of engine knocking is learned only after years of experience and proper training. Air in the fuel will cause a very pronounced knock which has a loud, dull sound rather than the sharp, metallic knock caused by a loose bearing. Knocks may be located by isolating the fuel from the cylinders one at a time. This has the same effect as shorting a sparkplug on a gas engine.

Safety, both to personnel and equipment, should be of first concern to every engine operator. Before attempting any repairs inside the engine, the locking device or other means of preventing the engine turning over, should be employed. Do not rely solely upon a disengaged engine clutch. Clutches sometimes overheat and drag enough to roll the engine over. Switches should be open on diesel-electric installations as the generator may become a motor due to current back-feeding from the main generators in use. Neglect in either case may mean the loss of an arm. Hands and other parts of the body should be kept away from the spray tip of a fuel injector being tested. Fuel leaves the tip at approximately the speed of sound and the fuel will penetrate into the flesh. Blood poisoning will be the result.

Well trained, alert engine operators are still in demand and will continue to be so until the day drilling rigs are run by atomic power.

REFERENCE

[1] Boatman, John A. "Care of Gas Drilling Engines." WORLD OIL, V. 130, No. 5, p. 110. April, 1950.

Inspection of the fuel injector timing and the proper adjustment of the intake and exhaust valve lash.

A New System of

Electric Logging

By WILFRED TAPPER and WALTON J. GREER
Vice President, Electrical Well Services Supervisor, Electrical Well Services Research
Halliburton Oil Well Cementing Company

THE AUTHORS describe the use of frequency modulation as a means for transmitting down-the-hole potential levels to the surface recording instruments without loss of pin-point accuracy due to the interference of cable leakage or other extraneous sources. The system, in operation for a year on the Gulf Coast, offers multiple records from one run of logging tool.

DURING the past few years accelerated efforts have been made to arrive at better interpretation of the data furnished by electric logs. Fundamental to proper interpretation of the log is the accuracy of the information recorded. It is imperative, therefore, that the instrumentation employed in measuring and recording the data be of a high order of precision. From an economic consideration, it is desirable that the maximum amount of information be obtained in the least practical time. A logging system employing electronic controls, vacuum tube metering circuits, and carrier frequency transmission signals can be made to provide the features listed as desirable. Such a system has been built and is in commercial operation. It is being called an FM logging system because it employs frequency modulation of the carrier waves used to transmit the measurements from the logging tool in the bore hole to the recording equipment at the surface.

From a consideration of the basic logging problem can be derived the technical requirements of an accurate logging system. In the common practice of resistivity logging, a constant value of current is introduced into the mud column and formations adjacent to the logging tool through a system of electrodes. Other systems of electrodes measure the resulting potential levels at different points along the bore hole. If the exact value of the current is known, the potential measurements indicate directly the apparent resistivities of the formations. If the current introduced into the formation should vary from its assumed value, then the potentials measured would also vary. This would lead to false readings of the apparent resistivities. It is thus quite important that the current to the formations be maintained constant throughout the logging operation if the potential measurements are to be used directly as measurements of resistivities. It would not be necessary to maintain the current constant if measures of both the current and the potentials were used to determine the resistivity value.

With such as the FM logging system, several methods can be employed to assure either that the formation current remains constant at some reference value, or that its value is constantly measured and the potential values corrected accordingly if it should vary. Since vacuum tube circuits detect and transmit the signals from the formations, very small signal levels are required. Consequently, it is necessary to introduce only a relatively small amount of power into the formations from the current electrodes. This amount of power can be made extremely small compared to the constant power required by the various vacuum tube circuits making up the measuring and transmission systems and that power dissipated in the cable itself. There is available, therefore, a great ballast action which alone can keep the formation current fairly constant.

The formation current can be generated within the tool itself by electronic tube circuits. The current output of such circuits can be made very constant. These types of circuits can be controlled by an internal regulator or by a signal received from an external source. This external source can be in the surface equipment.

A measure can readily be made of the actual current. This measure could be used to regulate directly the current source; it could be fed into the detecting circuits to compensate the values picked up for any possible changes in the current; or it could be fed into the recording equipment so as to vary the sensitivities in accordance with any variances in the formation current.

Thus, there are available several possible means of maintaining a constant formation current or of compensating for any variation that may be allowed in it. The logical procedure is to use one or more of these methods as needed to reduce to a tolerable level errors due to current variations.

Obviously, the potential values present at the pick-up points must be accurately measured and corresponding values faithfully reproduced at the input to the recording equipment.

Vacuum tube circuits provide nearly ideal measuring devices for currents and potentials known today even in the laboratory. The principal advantages of such circuits are due to their ability to measure a quantity while taking a minimum of energy from the source of the quantity being measured. Electrical quantities such as potentials or currents can be accurately measured without loading down the source of these quantities. If the measuring device used does load down the source, there are errors in the measurement.

Only two procedures are apparent for reducing the time factor in logging operations. One is to operate the equipment at greater speeds. The other is to procure as much information as possible at one time. Limits to the speeds at which instruments on the end of a wire line can be manipulated safely in bore holes are set by such considerations as the possibility of entangling the line or having the line overrun should the tool be stopped for any reason while going in the downward direction. If a tool moves at too great a speed in the up direc-

tion, there is a likelihood that an undue amount of stretch will be introduced into the line due to excessive drag on the tool and line. Should the tool hang up for some reason, there is the chance that the reel cannot be stopped soon enough to prevent a parting of the line. Thus, there are definite physical limitations to the speeds at which logging tools can be run in a bore hole.

It is desirable, therefore, to procure as much information simultaneously as possible. As drilling operations become more expensive, the need becomes even more urgent to secure a greater amount of information at one time. The need, therefore, is for a logging system which has no fundamental limitation to the amount of data which might be secured during one trip into the hole. With carrier systems, several channels can be transmitted over a single conductor cable simultaneously. With the additional possibility of sending several intelligence signals on each carrier, there does not appear to be a theoretical limit to the amount of information that can be transmitted over such systems at one time.

With an arrangement such as in the FM logging system, it is possible to minimize the effects of the logging cable. In conventional logging practice, it is necessary to have the current electrodes at the far end of a cable as much as three miles away from the power supply which furnishes the energy for the formation current. It is likewise necessary to have the recording equipment the same distance away from the potential pick-up electrodes. If the cable itself is a part of the measuring circuit, no appreciable changes in its characteristics can be tolerated during a logging operation. Characteristics of practical logging cables, such as leakage resistance, resistance of the conductors, and the magnetic properties of the sheath material may change under logging conditions. If these characteristics have an influence on the actual logging current or signals, changes in them may result in erroneous readings on the recorded log.

There is also an economic factor to be considered in the use of logging cables. Cables of greater lengths and strengths, as needed for future oil wells, are obviously going to be more expensive. It is desirable for the logging company to use the cable for long periods of time without repair or replacement. The optimum time for the replacement of a logging cable is dictated by the physical strength of the cable. If a cable must be repaired or replaced because of characteristics such as electrical leakage, a considerable expense will be added to the operations.

It thus becomes apparent that a desirable logging system would be one which, among other features, does not use the logging cable in the measuring circuits.

For a logging system built completely around electronic tube circuits, it is necessary to transmit down the cable to the tool only that power required to operate the circuits. This power can be transmitted at an impedance level low in comparison with line leakages to be expected even with a relatively poor cable in a deep and hot hole. Thus, there is likely to be little effect on the power being transmitted down the cable by reasonable changes in the electrical characteristics of the cable. Vacuum tube circuits can be designed so that their operation is not affected by even fairly large percentage changes in power supplies. It is possible, therefore, to reduce to negligible values what effects the cable might reasonably have on the supply power during a logging operation. For the transmission of the signals from the tool to the surface, it is possible through the employment of carrier frequencies to make this part of the system practically independent of the characteristics of the line. These signals can be transmitted at an extremely low impedance level so that even under the worst conditions, expected changes in the cable

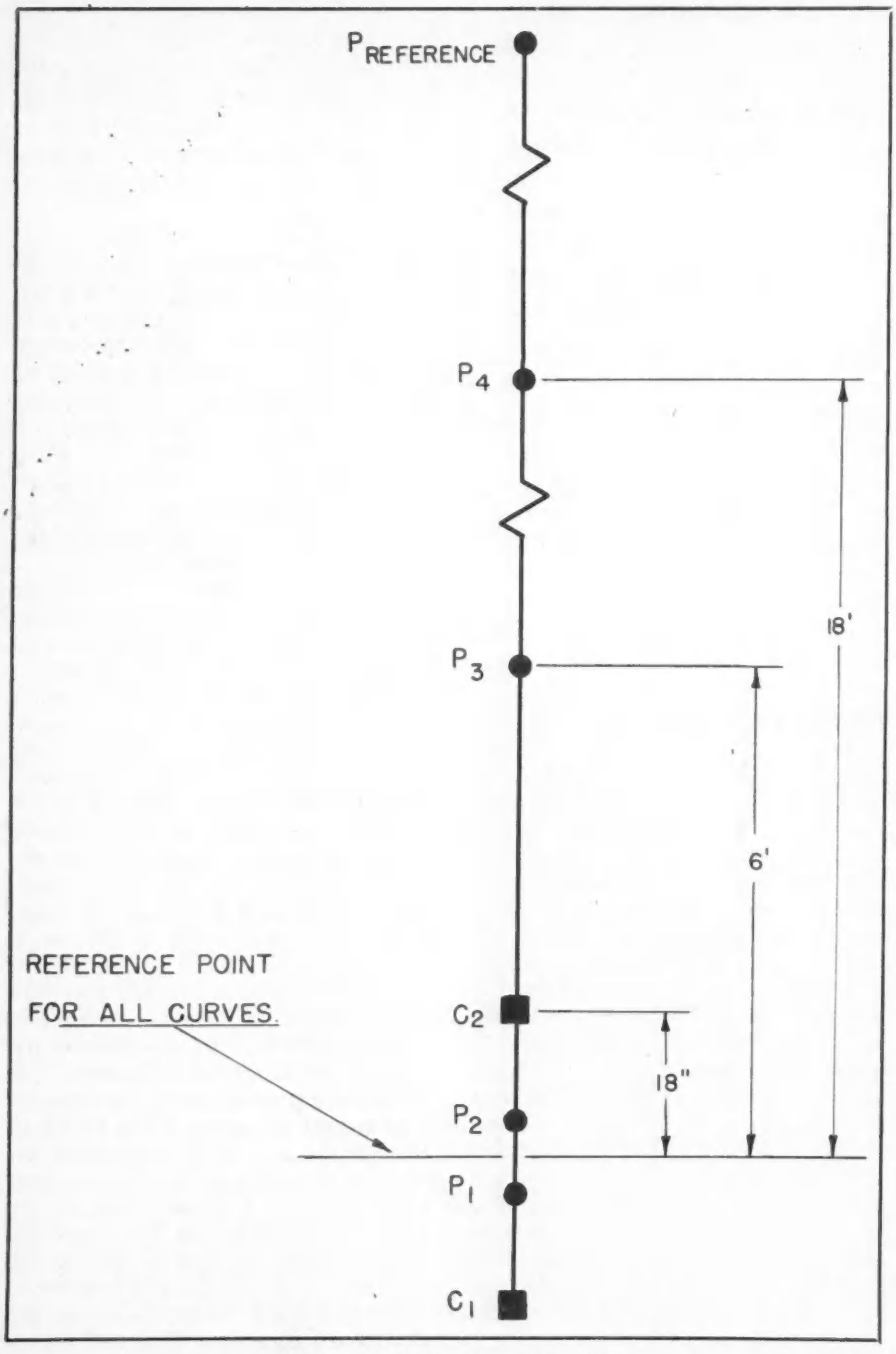

FIGURE 1. FM electrode configuration.

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characteristics will have little effect on the signals. Any of several modulation methods, and particularly one employing FM, results in the exact measurement being recorded at the surface regardless of what may have happened to the signal since it left the tool, provided a minimum strength of signal is received. This minimum signal can be of the order of tenths or less of that normally available in a well designed system.

Thus, it is possible with electronic tube circuits to build a logging system to make several subsurface measurements simultaneously with a high degree of accuracy and to transmit these measurements unaffected to the surface. Such systems can be made which are unaffected by wide variations in cable characteristics.

The selection of vacuum tube circuits for making the measurement, and of carrier frequency systems for the transmission of these measurements in electric logging, is quite logical.

Several technical developments within the past few years have contributed to the design of fieldworthy carrier transmission systems for electric logging.

First among these are important developments in electronic circuit design. Developments of such electronic circuits as those used in guided missiles, proximity fuses, radar, television, telemetering, and industrial electronic control, have opened many new fields for the application of electronic circuits. Through the use of feedback and other operations in proper circuit design, it is possible to provide for reliable and stable operation even though individual circuit elements may be subjected to changes.

Other important developments have been in construction of electrical components with such temperature characteristics that they can be subjected to the high levels of temperature and the great temperature variations to be encountered in logging operations. The components have been developed in such small sizes that they can be built into the relatively small tools required.

The system as now being constructed employs three frequency modulated carriers to transmit three apparent resistivity measurements simultaneously. The potential measurement is transmitted as a direct current signal as in other systems.

There are several advantages of frequency modulation over other types of modulation which indicate its use in an electric logging system. For a theoretical or mathematical comparison of modulation systems as to the effects of noise interference, cross talk between channels, and other such considerations, reference should be made to the many texts on communication systems.

There are, however, characteristics of frequency modulation that can be discussed qualitatively to illustrate the advantages of such a system. Stable vacuum tube circuits can be made to oscillate and to be modulated in frequency. By the proper design of the circuits, and the use of the proper elements, systems can be constructed which are unaffected by temperature changes up to that level at which the connections melt. It is possible to convert a change in any electrical value into an exactly corresponding change in the frequency of the oscillating circuit. There can thus be provided in the logging tool a source of alternating current which is made to deviate in frequency in accordance with the intelligence which is to be transmitted. One or many such alternating current signals can be fed onto a single conductor cable. There can be provided at the surface instruments which respond only to the frequency deviations. These instruments can be made to drive a recorder in such a manner as to indicate faithfully on a chart the exact values which caused deviations in the frequencies of the oscillators in the tool. The recordings can be made accurate as long as a bare minimum of signal is received at the surface, regardless of what interferences might have been introduced along the transmission path or cable. Changes in leakage resistance of the cable, conductor resistance, or magnetic characteristics of the sheath of the cable may result in changes in the strength of the signal but such changes will not affect the frequency deviations. Extraneous signals due to induced currents or other electrical noises introduced along the transmission path may result in considerable

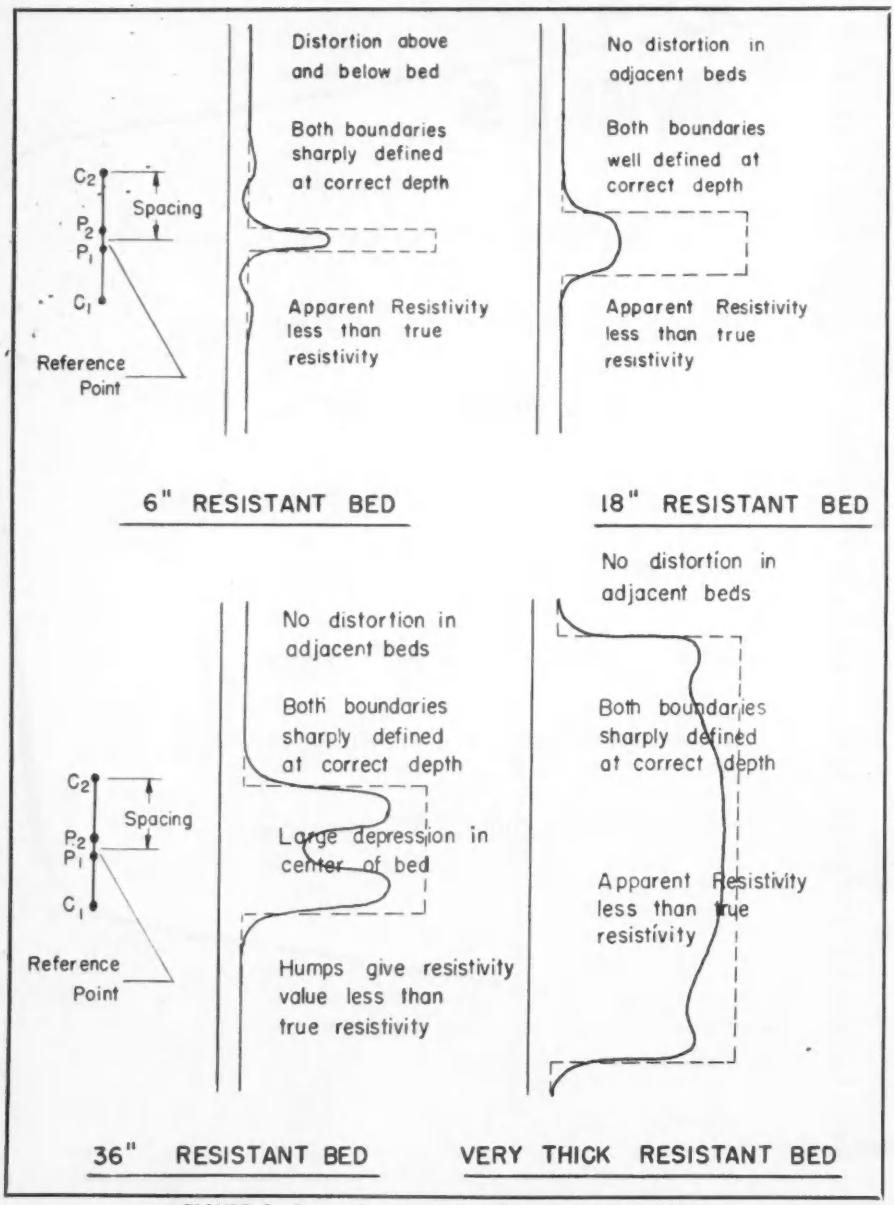
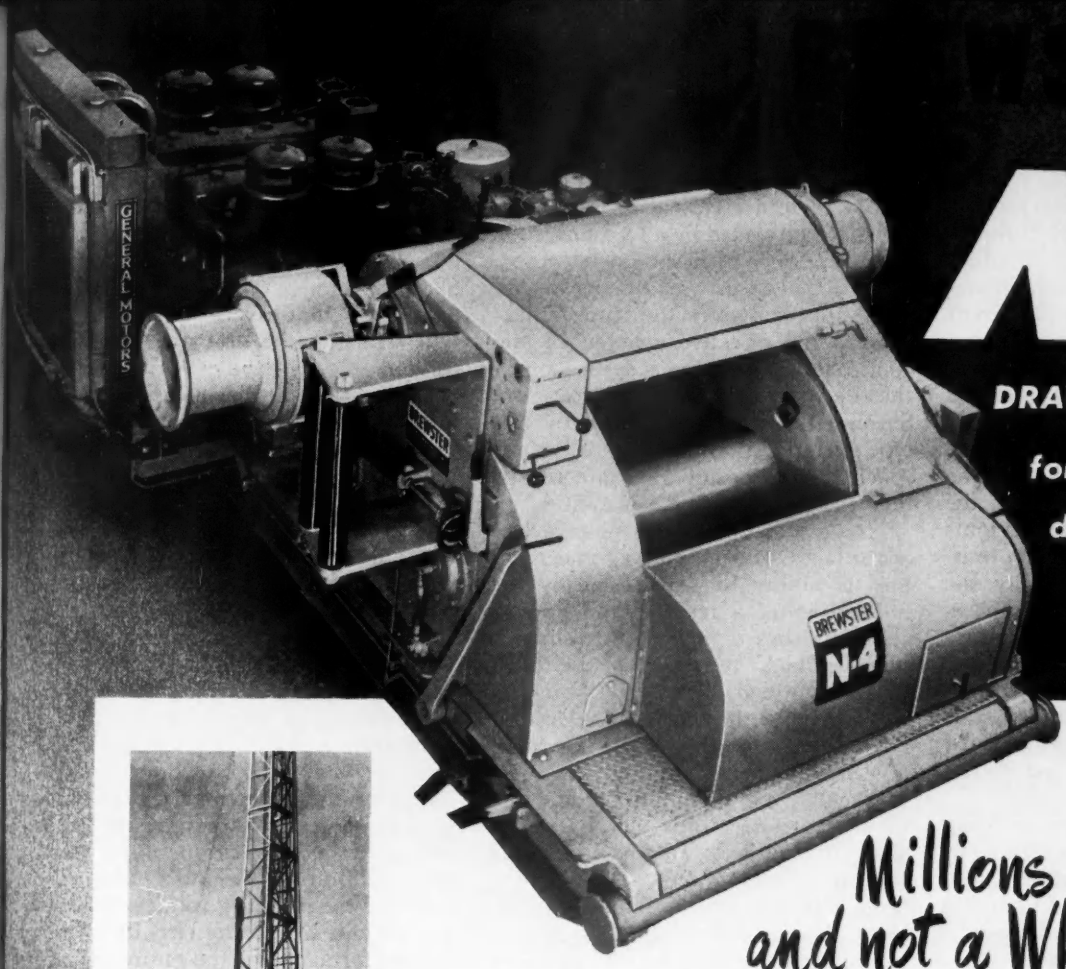


FIGURE 2. Curve characteristics—four electrode method.



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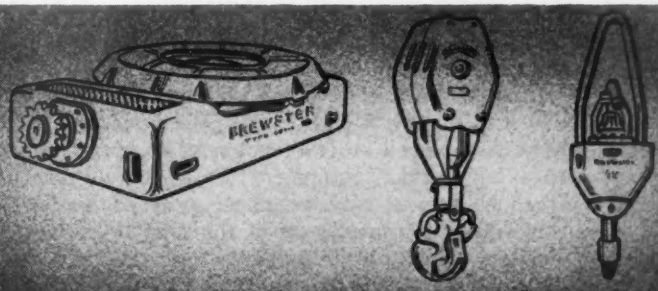

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amplitude effects on the signal, but these will be of little importance since the receiving equipment does not sense them.

The actual log produced by the new FM system is not greatly different from that being produced by the older methods. There are the conventional potential curve and three apparent resistivity curves.

The electrode configuration now being used in the Gulf Coast area is shown in Figure 1.

The potential curve is picked up by electrode P_1 or P_2 or both. The formation current passes between the electrodes C_1 and C_2. A balanced four-electrode short-spaced apparent resistivity curve is determined by the pickup electrodes P_1 and P_2. A three-electrode medium-spaced apparent resistivity curve is determined by the pick-up electrodes P_3 and Reference. A three-electrode long spaced apparent resistivity curve is determined by the pick-up electrodes P_4 and Reference.

The three-electrode curves are similar to those commonly furnished by other logging systems. The balanced four-electrode short-spaced curve is probably new in commercial logging. It has unique features that are illustrated in Figure 2.

So far as is commonly known, no ideal electric logging configuration has been devised. Each curve has distinct advantages and limitations. All of these should be realized when interpreting any electric log. For two specific conditions there are typical distortions in the curve furnished by a four-electrode configuration which should be noted. First, if the resistive bed being logged is of approximately the same thickness as the effective spacing of the configuration, there is a depression in the center of the bed indication. Second, the values furnished by this type of configuration in relatively short spacings are considerably affected by hole size and by mud resistivities.

As a correlation curve, the principle advantages of such an arrangement are its ability to define sharply the boundaries of a resistive bed and its characteristics of always furnishing a positive "kick" regardless of the thickness of the bed. The single point resistance log is the only other electrode configuration that can be made to give such a high degree of definition.

The logging system itself does not dictate the electrode configurations that can be used. In fact, with this logging system there is available a large selection of possible configurations. This is due to the fact that all active electrode circuits are contained in the tool itself and they do not have to be tied directly into the surface equipment. Thus, any desired number of active electrodes can be used.

Several practical considerations led to the selection of the combination of configurations being used on the Gulf Coast. It offers a logical group of curves to furnish the data now required of electric logs. All curves are of the same general type. Some workers believe that several curves of this type will give the best data available for quantitative studies. With the arrangement employed, all curves have exactly the same depth reference and this reference is within two feet of the bottom of the tool. The electric field for all curves is established by one formation current circuit operating continuously. The complication involved in the use of several formation current circuits, or of commutating the output of one source through different electrode circuits, is avoided in this particular case.

Through the use of carrier signals from the surface, it is possible to control the circuits in the logging tool. The formation current is turned on or off as desired. Standard resistance values of high precision are inserted into calibration circuits within the tool and the resulting voltages fed into the various measuring circuits so that the performance of the entire logging system can be checked and calibrated. This operation can be performed before, after, or during a logging operation with the tool in or out of the well. Use has also been made of switching possibilities to change the various configurations being employed so additional sets of curves can be furnished without having to bring the tool to the surface.

The new logging system shows that many features desirable in a logging equipment, and not previously available, can be realized through the use of carrier frequency channels and other applications of modern electronic circuits. To the present time, the developments employing these principles have been confined to a logging equipment which furnishes data not greatly different from what is supplied by other systems. One year of commercial operation in one area has demonstrated that equipment of this type can be made fieldworthy.

It is believed that the instrument development described herein is fundamentally sound and that such systems, employing carrier frequency transmission and electronic control, are the least likely to limit instrument developments in the future.

The possibility of transmitting electric logs by radio or telephone from remote or marine location is an actuality with this system. The future developments possible with FM are numerous.

About the Authors

WILFRED B. TAPPER received his master's degree in geology from the State University of Iowa in 1939, and that year joined Halliburton Oil Well Cementing Company, Duncan, Okla., as geologist. While completing his education, he had worked as a field geologist and draftsman with the U. S. National Park Service and the Iowa Geological Survey. Advancing rapidly with Halliburton, he was district geological engineer of the North and East Texas districts when he was called to duty with the Navy in 1943. He returned to the company in 1945 in the Electrical Well Servicing department in Dallas. He was named general manager of the department at Duncan in 1947, and in July of this year was chosen vice president in charge of the department for the company.

WALTON J. GREER, who since 1947 has been supervisor of Electrical Well Services research for Halliburton Oil Well Cementing Company, received a B.S. degree in electrical engineering from Rice Institute in 1935. After completing his education he joined Houston Lighting and Power Company as commercial power salesman. In 1938 he was employed by Halliburton as an operator of electrical well services equipment, a post he held until 1942, when he became a radar officer attached to the Army Air Forces, stationed most of the time at Wright Field, Dayton, Ohio. On his separation from the service in 1946, Greer organized and became the first president of Well Instrument Developing Company, a position he held until 1947, when he rejoined Halliburton.

Baash-Ross News

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Take a look Inside . . .

and see why the Baash-Ross Roller Kelly Bushing is so unusually efficient!

Important Performance Facts on the Industry's Most Famous Bushing

Baash-Ross Roller Kelly Bushings are setting such outstanding performance records wherever they are in service that a constantly increasing number of oil men are asking for more information on the "fine points" of roller bushing design. The following are typical of questions we are frequently asked in the field. Perhaps your question is answered here. If not, our engineering department will be glad to explain to you the engineering "why" of any point you wish to ask about.

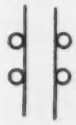
Q Why use *two* rollers in contact with each kelly face? Wouldn't one large roller on each face serve as well?

A. Definitely not. Two rollers give vertical stability to the kelly—prevent it from gyrating and wobbling—hold it steady at *all* table speeds and under *all* drilling conditions, rough or smooth

One roller on each face would not give this vertical stability . . . would permit the kelly to wobble and gyrate over a wide arc—which, in turn, would not only reduce drilling speed and efficiency, but would also cause severe strains on table bearings, swivel bearings and pipe connections.

Another important point—one roller for each face would necessitate the rollers being quite large in order to prevent "corrugating" the kelly. Large rollers mean high inertia—are slow to start, slow to stop and prevent instant response to kelly feed. But by using two rollers against each face, ample driving surface is secured with rollers that are compact, quick-turning, quick-stopping. Result—*instant response to the most delicate bit feed!*

One roller permits wobble



Two rollers maintain alignment

Bronze bushing prevents steel-to-steel contact

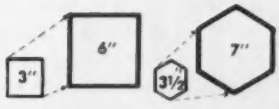
Q Why do you use a bronze bushing between each roller and pin? Wouldn't it be easier to simply use larger pins and eliminate the bronze bushings?

A. It would be easier, yes . . . but not good engineering. The bronze bushings serve a very important function by preventing steel-to-steel contact between rollers and pins. As most engineers know, steel against bronze gives a much better bearing surface than steel-on-steel. It not only resists galling under higher loads, but also carries more efficiently the heavy driving pressures set up between the pins and rollers.

And speaking of the pins, here's another valuable design feature . . . Because there is no pressure (therefore no wear) on the back side of the pins, these have been designed so that they can be easily reversed to bring the unworn back side to the front for additional life after the front sides are worn. Cuts maintenance to a minimum and insures peak performance *longer* without replacements.

Q Do you need a separate Baash-Ross Roller Bushing for each size kelly?

A. No. The same bushing can be quickly changed from one kelly size to another by merely lifting out the roller assemblies—which come in sets—and replacing them with a new set of the desired size. It's simple, fool-proof, quick . . . and cuts kelly bushing investment to a minimum. For example, the same Baash-Ross Bushing will fit *all* square kelly sizes from 3" to 6" by simply changing roller assemblies. Or, when using Hex kellys, the same Roller Bushing will fit all Hex sizes from 3½" to 7" by changing only the assemblies.



Q It's a well-known fact that close bushing fit is important when using Hex kellys. Can you maintain close fit with the Baash-Ross Roller Bushing for Hex kellys?

A. Absolutely! In fact, the Baash-Ross Hex Roller Kelly Bushing is designed so that all you do to adjust the fit is lift out the roller assemblies and remove one or more shims below each assembly. Working diameter is reduced exactly 1/32" for each shim removed, so it's easy to make accurate adjustment without complicated operations.

Get the complete story on Baash-Ross Roller Kelly Bushing advantages before you invest in any bushing. Your near-by Baash-Ross representative will be glad to supply further details on this modern bushing—or write direct for full information.

SAFETY TRAINING By Specific Practice Problems

Part 7

Fluid Pressure Hazards in Rotary Drilling Operations

By J. I. POWELL, Consultant

THE pressure exerted by drilling fluid in its enclosed system has been the basic contributing cause for many serious accidents. These accidents, of course, can be prevented through proper training procedures, physical safeguarding, and appropriately designed equipment.

To train drilling rig crewmen to avoid the circumstances known to produce this type of accident, actual knowledge of past accident experiences is necessary.

Drilling fluid pressure hazards, as associated with a rotary drilling rig, are found at a number of different points within the rig setup; one such is in connection with a fluid pressure relief valve.

The particular type of relief valve referred to is one that is actuated or opened by pressure sufficient to shear a steel pin or nail in two. Because of its self-actuating feature this type of valve will open under very unpredictable circumstances.

One such occasion which would cause the valve to open suddenly and without previous warning would be for the drill bit to encounter a much softer formation than was previously being drilled. This softer formation may be of such consistency that, aided by the "stretch-out" and weight of the drill string, could produce a plugging effect on the fluid orifices of the drill bit. When such an action does take place in the bottom of the borehole, the fluid pump will, of course, build up an excess pressure while pumping against such an obstruction.

Such an excess pressure may be sufficiently high to shear the nail in two in the shaft of the pressure relief valve. During such an instantaneous opening of the valve there are several ways in which a crewman might be injured.

In studying physical arrangements of the valves with regard to how they were installed, it was found that height was a factor in the causes for accidents, but not the sole contributing cause.

Relief valves have been found installed so as to be at the height of a man's head while he is standing adjacent to the pump. The fluid release orifice of these valves has been found without a drain pipe attached, and the open orifice has been found directed toward where crewmen continuously walk. Crewmen have stood directly in front of the open orifice without suspecting the valve would open at that critical moment.

Men have lost their eyesight by the high pressure surge of drill fluid. It must be remembered that immediately before being released the fluid may have a pressure range from 500 to 1000 pounds per square inch. Drill fluids, too, contain abrasive materials.

The simple remendy for preventing this type of accident is to install a drain from the relief valve orifice as soon as the pump is placed on a new location. Such a drain should preferably be extended so that any discharged fluid will return to the mud pit.

A condition that could be readily discovered and one which would cause the relief valve to open is for the slush pump to be started and pressure built up against a closed, manually operated valve in the standpipe. Unfortunately, this kind of act has already occurred and at a time when crewmen were working in close proximity to the relief valve. In incidents of this nature where the valve shaft and shear pin are not adequately enclosed and a drain is not attached, crewmen in the immediate vicinity are exposed to potentially serious injuries.

Aside from the danger of being hit in the eyes, face or body with a surging flow of high pressure drilling fluid, there are still other hazards involved with a relief valve that is not properly safeguarded.

The shear pin (usually a nail) used in the valve shaft is often smaller than the holes in either the shaft or the bonnet of valve. When the valve shaft is thrust upward by an actuating fluid pressure, the sudden shearing effect between the shaft and bonnet often causes both pieces of the sheared nail to fly outward. At such a time and unless there is an enclosure guard over the nail pieces as they are turned loose by the forceful shearing action, the pieces could strike a standing or passing crewman.

The force and speed with which these nail pieces can fly through the air is, of course, dependent upon the amount of resistance they have in leaving the holes in the valve bonnet. However, under unrestained circumstances, one of the flying nail parts would undoubtedly have sufficient force to completely destroy the sight of a person's eye.

During the normal course of drilling ahead in hard formations, crewmen are often called upon to clean and paint certain pieces of drilling equipment. Where there are no unusual exposures involved with regards to these crewmen likely getting caught in the moving pieces of equipment being cleaned and painted, such in-

ACCIDENTS TRACEABLE to ignorance or carelessness in the handling of high-pressure drilling fluids and the equipment required therefor takes a high toll of man-hours on the rig and unless special effort is directed toward education of the crew, hidden hazards in the mud system often pass unnoticed. The author describes accidents and injuries sustained through mud-system failures, and outlines safe procedures.

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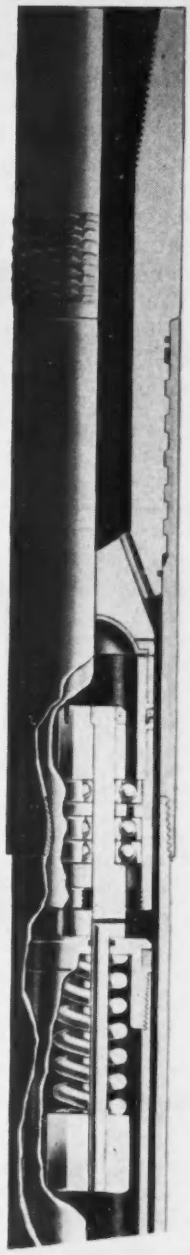

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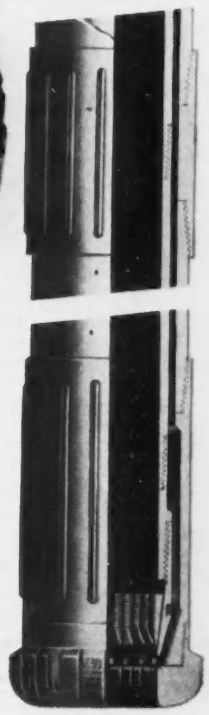

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structions are consistent with safe performance codes.

In a study, however, of past accident experiences it has been found that moving pieces of equipment which can be seen or their movement predicted is one subject. The equipment and devices that move only on an unpredictable basis is still another.

One such device whose movement is primarily unpredictable is the pressure relief valve in the drill fluid pressure system. In other words, a crewman whose work requires him to be in the immediate vicinity of the pump while it is in motion has little on which to base his prediction that the relief valve will open at any given time.

There was a mishap through which a crewman had the flesh of the palm of his hand literally torn from the bones. He was standing on top of the pump using a solvent saturated rag to remove grease in preparation for applying a coat of paint. The other hand, not being used to wipe with, was resting rather heavily directly on the protruding end of the relief valve's shaft.

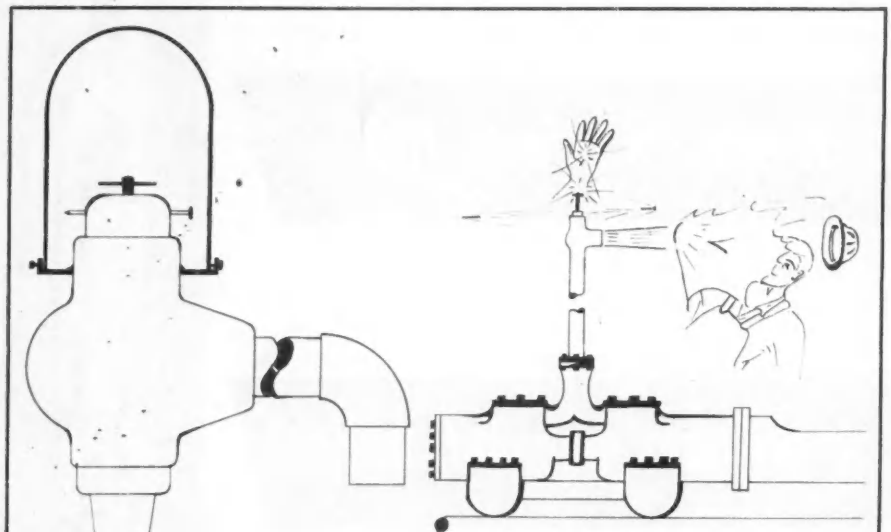


FIGURE 1 (left). Housing over the shear-relief valve is shown together with indicated drain or flow line for released stream when valve functions.

FIGURE 2 (right). Sketching two of the mishaps which may occur when the shear-relief valve is not protected and when the discharge line is open at dangerous height.

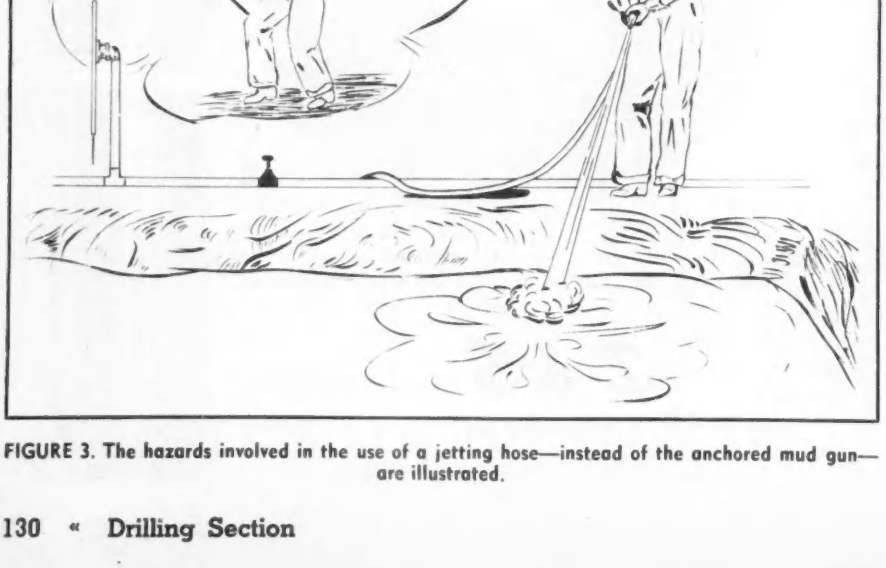


FIGURE 3. The hazards involved in the use of a jetting hose—instead of the anchored mud gun—are illustrated.

At that instant something happened down in the borehole that caused the pressure to increase sufficiently to shear the nail in the shaft. The shaft shot upward with a powerful thrust as the valve opened and released the excessive pressure within the system. The force behind the thrust that was responsible for tearing the flesh from the man's hand was a fluid pressure of about 800 pounds per square inch.

In accident prevention work on drilling rigs, it is important to train crewmen to have a cautious respect for any piece of equipment that can move. Safeguards can be installed that will protect crewmen against contact with a potentially dangerous device in some situations, but unfortunately, not all.

A safeguard can be made which will prevent a crewman from thoughtlessly placing his hand on the top of a relief valve shaft. Many now in use are made from a regular line pipe bull plug. A welder usually tack-welds a four-inch collar to the body of the relief valve. The four-inch bull plug is then screwed into this collar.

Care should be taken in attaching the collar so that the plug will allow space for the shaft to travel upward without striking the top of the plug.

The advantages of an enclosure guard of this type are two-fold: (1) the sheared parts of the nail will be confined within the enclosure; and (2) crewmen may safely rest their hands on the bull plugs without being hit by actuated shafts.

Jetting Hose

The mud jetting hose used for agitating drill mud in the pits has, in most operations, been replaced by modern, safely designed, steel mud guns. Some rubber jetting hose are, however, still being used. These hose, if used under proper conditions, are reasonably safe. The danger lies in the contributory causes for such accidents.

There are two principal contributory causes for the rubber jetting hose having inflicted serious injury upon their users. One is that excessive pressure is built up within a hose by too great a flow of fluid for the nozzle to handle. The other is that a temporary obstruction within the nozzle will choke off the flow of fluid and thus build up an excessive pressure within the hose. Excessive pressure, of course, causes the nozzle-end of the hose to whip violently.

A drilling rig crewman was seriously injured as a result of being on the end of a violently whipping mud jetting hose. He was unable to hold fast to the whipping-end of the hose and at the same time retain his up-

right posture and keep his feet on the ground. He thought it better not to turn the hose loose from his grasp for fear the heavy nozzle and clamps on the end of the hose would slash him across the face.

He was eventually pitched forward with one of the hose's whipping motions. This caused him to land in the middle of the mud pit by which he was standing and across the board trap that was installed to catch well cuttings. The side of his face struck the sharp-edged top of an upright stake holding the trap in place. The upper half of one side of his face was badly mangled.

The act that started the hose into its whipping motion was committed in a prankish manner and without sufficient thought being given to probable final consequence. A fellow crewman, seeing his friend holding the mud spouting hose alone, decided it would be fun watching him struggle with the hose under a tremendously increased pressure.

This fellow crewman, therefore, knocked the throttle wide open on the motor that powered the auxiliary mud conditioning pump. He then ran to another point to avoid being seen near the motor's throttle. It was too late for him to get back to the throttle when he realized his friend was not going to be able to hold the whipping hose and stand on his feet.

Even in this man-made accident, the end result of the act was not calculated beforehand by his fellow worker. It would indeed be a very rare case where anyone actually intended to cause serious bodily harm to someone else through a prankish act. One crewman may feel like striking a harmless fear in another and commit an act with that limited intention. The reason for this is that he has not been trained to visualize the probable consequences that often do occur in addition to their original limited intentions. Such limited intentions are usually confined to striking fear and creating excitement. The additional and unsuspected consequences sometimes cause death.

The other contributing cause for accidents with mud jetting hose is for something to obstruct the flow of fluid through the hose nozzle. The manner in which many of the hose nozzles are made-up—with pipe nipples and reducers—produces a design which makes it easy for the fluid flow to be obstructed. The end nipple or jet-end of the nozzle is usually either a three-eighths or half-inch nipple. These are made up into either a reducer or a bushing. The reduction of size at that particular point produces a concave pocket into which can flow a small pebble or shale chip of greater size than can actually pass through the smaller jet-end of the nozzle.

A pebble or shale chip of just the right size can, of course, easily form an obstruction to the flow of fluid. This obstruction can, in turn, be the cause for a sudden pressure rise within the hose.

Drilling rig crewmen have been seriously injured when a sudden rise in pressure produced in this manner caused the hose to begin whipping in a violent manner. The nozzle-end of the hose is often whipped from the grasp of at least one of the user's hands. As the nozzle whips to and fro it often strikes a man across the face or in an eye.

The most practical solution for preventing the recurrence of this type accident is to redesign that part of the nozzle that is inserted into the hose for clamping. In other words, if that portion of the nozzle inside the hose, excluding an area necessary for clamping, is tapered to a cone shape and this area slotted with small diameter slots, a pebble or small shale chip could not obstruct all of the openings at one time. Thus, by eliminating a design capable of producing a sudden pressure rise within the hose, the probability of accidents will also be greatly reduced.

Mud Guns

Modern, high-pressure tested, tubular steel mud guns, with movable

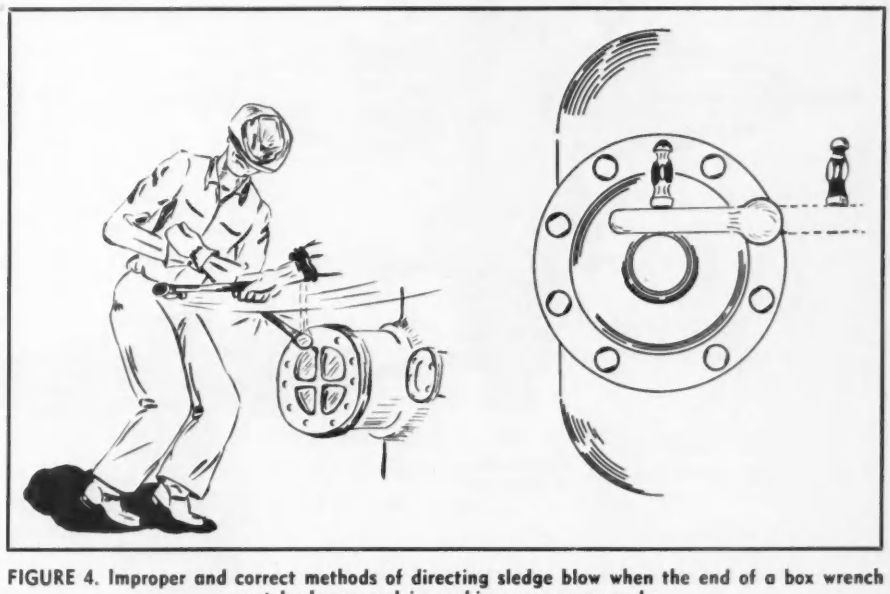


FIGURE 4. Improper and correct methods of directing sledge blow when the end of a box wrench must be hammered in working over pump ends.

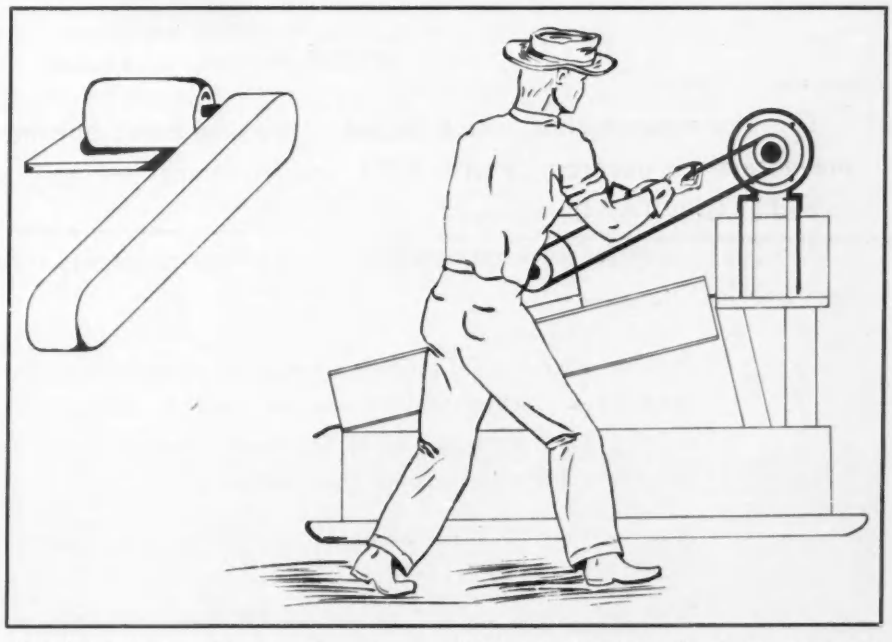
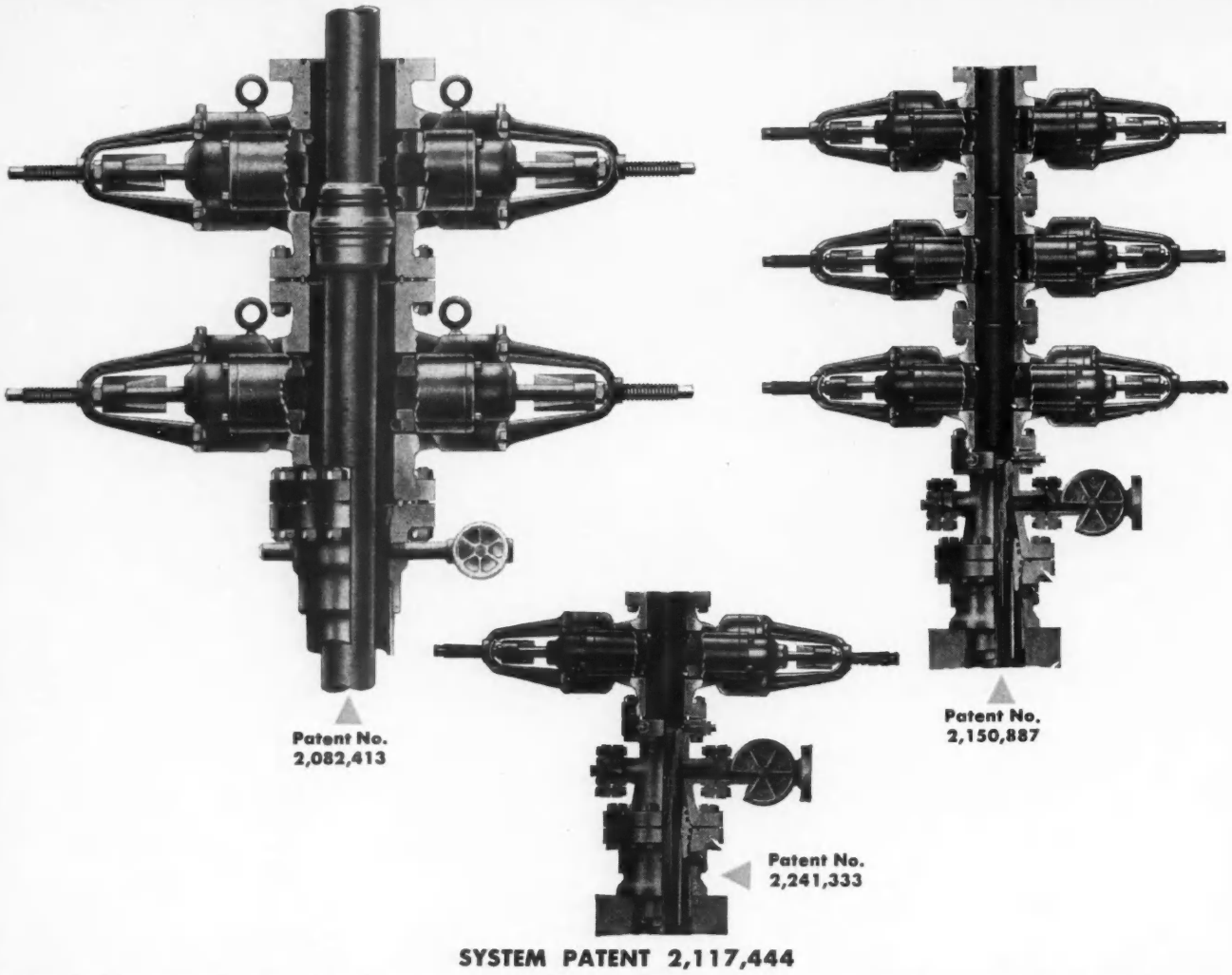


FIGURE 5. Bad practice in attempting to remove a V-belt on a shale-shaker drive is here illustrated. Belts should never be removed while shaker or driving unit is operating, and hands should be kept outside the area enclosed by the two belt sections.

GRAY SYSTEMS



SYSTEM PATENT 2,117,444

The above assemblies, which include "the new bored-out master valves and blowout preventers" in accordance with A.P.I. specifications, are covered by the above patents owned by Gray Tool Company.

A recent court decision approved the following statements referred to in said decision as Material Facts:—

Material Fact 3: "Oil producers who purchase equipment from Plaintiff (Gray Tool Company) for use in the combinations and methods covered by the second, third and fourth patents in suit have an implied license as a matter of law to use the same in the said patented combinations and methods."

Material Fact 4: "Oil producers who purchase equipment from Plaintiff's (Gray Tool Company's) competitors for use in the combinations and methods covered by the second, third and fourth patents in suit do not have any implied license as a matter of law to use the same in the combinations and methods patented by Plaintiff's second, third and fourth patents in suit."

SOF WELL CONTROL

In accordance therewith:

(a) Those who purchase equipment, including master valves and blowout preventers, for assembly into the above illustrated patented combinations from Gray Tool Company have an inferred right to assemble and use these assemblies as a matter of law. It would, therefore, seem that rights to use equipment in practicing the teachings of Gray patents are automatically transferred with the purchase of equipment from Gray Tool Company as a matter of law, wholly divorced from any act which is within the province of or vested in Gray Tool Company.

Thus, additional rights to use equipment purchased from Gray are unnecessary.

(b) Those who wish to purchase said equipment, including master valves and blowout preventers, from others, do not have a right to assemble and use said equipment in accordance with the teachings of Gray Tool Company patents, until such rights are obtained from Gray Tool Company through the execution of licenses to use, which licenses are available.

Licenses which provide rights at a reasonable fee for the use of equipment in Gray patented combinations, regardless of where the equipment is purchased, are available and offered to those who desire such rights.

Gray solicits your patronage for equipment used in our patented combinations and assemblies, including your choice of Shaffer or Cameron control equipment, such as blowout preventers and master valves, for which we are agents.

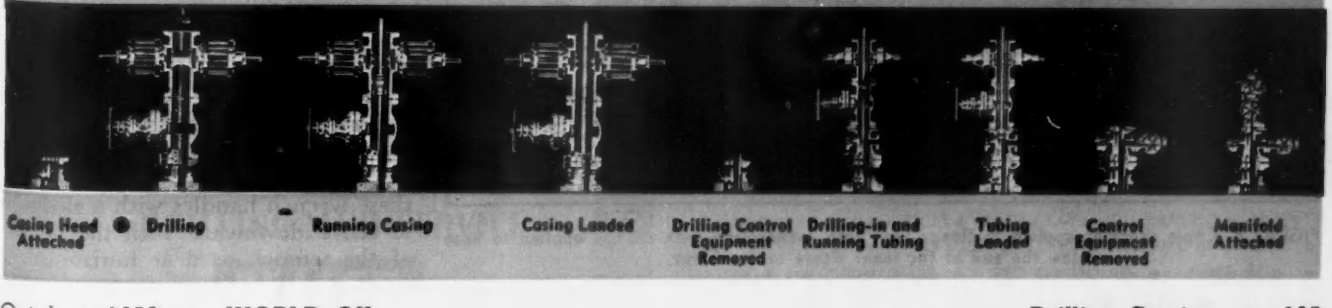
The purchasing of equipment for the entire patented assembly from Gray will assure you a planned coordinated unit rather than unrelated parts, plus unit responsibility as against divided responsibility.

If sources of supply other than Gray are desired, please arrange for a license to use the teachings of our patents, in order that said teachings may be used without infringement.

Note: licenses to manufacture and sell, including inferred rights to use, are also being offered to those who desire rights to manufacture our patented equipment.

GRAY TOOL COMPANY
HOUSTON

***Rocky Mountain Representative:* CARL MOULDEN, P. O. Box 1890, Casper, Wyoming**



joints that allow horizontal and vertical movement of the spout, are being extensively and safely used. Not all of the drilling operators, however, are taking advantage of their opportunity to reduce potential accident sources through use of these safer mud guns.

Mud guns are still occasionally found in use that are made up from regular low pressure line pipe and fittings. Usually a street ell is screwed onto a vertical pipe riser attached to the main mud pit mixing line. A pipe tee is screwed onto the male end of the street ell. A nipple, reducer and smaller tubular spout are then made up into one end of the pipe tee. A long nipple, collar and bull plug are then screwed into the other end of tee for use as a handle.

All of the movement necessary in directing the spout of mud gun must take place between the threads of the street ell, tee and pipe riser. In order to allow hand movement in directing the spout, these threads must be reasonably loose. This looseness between threads eventually allows some leakage to take place. Abrasive materials in this fluid leakage gradually abrade the threads to the point where their ability to hold this work-bench-made mud gun together under high pressures is extremely questionable.

Such badly abraded threads have, in fact, given away under excessive pressure. The men holding onto these guns at the time have been injured in a number of different ways. A gun thus turned loose from its fastening is usually propelled forcefully away from the riser by the high pressure column of fluid. Guns flying through the air have struck men on their heads with a terrific impact. Crewmen, too, have been pitched bodily into the open mud pits and adjacent obstructions. Pieces of heavy pipe and fittings comprising a five or six foot mud gun, on being torn loose from its fastening by a three or four hundred pound pressure, can inflict serious injury.

The most practical, safe solution for preventing this type of accident is, of course, to install the specially designed and high pressure tested mud guns that have been proven safe.

Rotary Hose

The rotary hose, as a connecting link in the drill fluid pressure system, has on a number of occasions been a contributing cause for drilling rig crewmen being seriously and even fatally injured. Such accidents have occurred in consequence to the rotary hose being blown apart by excessive fluid pressures from within. The falling ends of these hose have struck the crewmen who were working on the derrick floor below.

The shear pin type relief valve should be given credit for eliminating many accidents of this type that might otherwise have occurred. This valve, however, cannot be held accountable for not releasing pressures that would be dangerous in a rotary hose that has long been subjected to excessive abuse and neglect. Too much dependence is sometimes placed on the relief valve by a tool pusher or driller in an effort to get more service out of a rotary hose that has begun to look dangerous.

Everyone cannot, of course, be a perfect judge as to the remaining safeness left in an abused appearing rotary hose. Some hoses appear as though they might part on the slightest provocation and yet continue to give safe service for a considerable period.

Rotary hose can be made secure, in a great measure, against falling to the derrick floor through the use of safety chains and cables. The point in a rotary hose at which the parting more often takes place is either within the connector fittings or in the immediate vicinity of them. Substantially strong cables or chains, attached by clamps to the body of hose some eighteen inches below the connector fittings, with the other ends attached to swivel and standpipe, will serve as real life-saving safety devices.

If an excessive fluid pressure then does blow the hose apart within either of those two areas protected by the safety chains or cables, these will prevent the hose end from falling onto and sweeping the derrick floor.

Accident Statistics

An analytical study of 700 drilling rig accident experiences was made prior to the preparation of this paper. One of the purposes was to determine the number of accidents out of this total that were involved with performance acts associated with the drilling fluid system.

It was found that 56 out of the 700 had a relationship with the numerous acts necessary to the functioning of the drilling fluid system. These 56 accident experiences were then used to outline a specially designed operational practice which was termed: "Drilling Fluid System Practices."

This general practice was then broken-down into phases. In other words, a slush pump is the principal piece of equipment in the drilling fluid system. This pump, like all other pieces of drilling equipment, occasionally has to be worked on by the crew.

"Pump Repair and Maintenance" was the designation set up to which all accident experiences so involved were assigned. There were 28 accidents out of the 56 or 50 percent that were associated with this phase of the practice.

Five of these were involved with the acts of removing and replacing valve and cylinder head caps. Two fingers were severely lacerated and the bones fractured through glancing hits with sledge hammers. The sledge hammers glanced off the semi-vertical wrench handles as the sledge was swung sideways.

The safest method to use in striking these wrench handles with a sledge is to strike downward with the handle of the wrench as near horizontal as

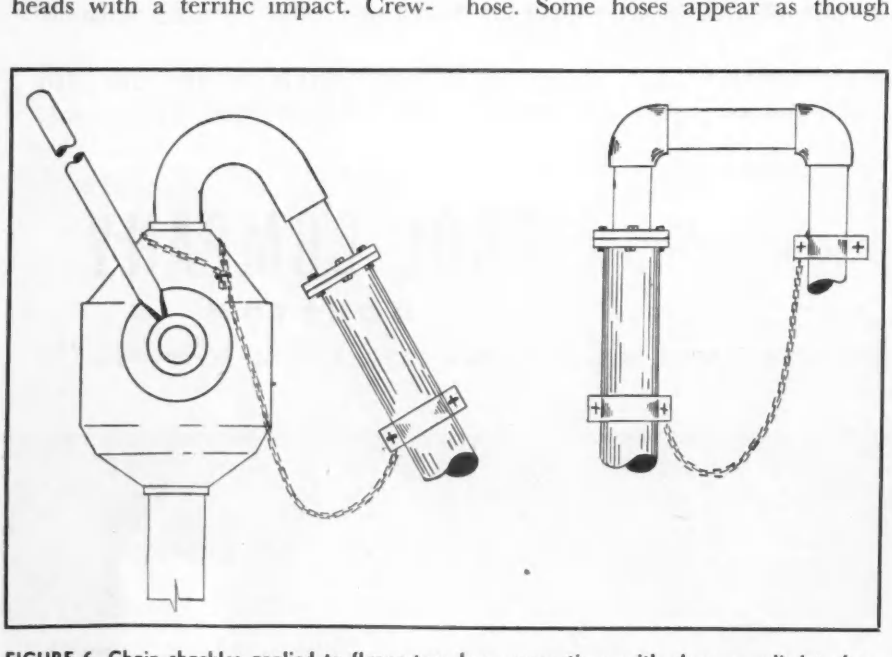


FIGURE 6. Chain shackles applied to flange-type hose connections, with clamps applied to hose below the end of the inner sleeve of connector.

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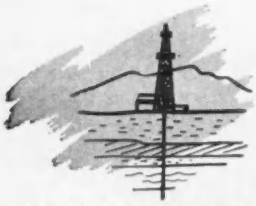
TOPS IN THE FIELD!



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possible in case of cylinder heads. Short, bumping strokes should be used on valve cap nuts.

Other accident experiences involved crewmen who got their hands caught between the packing glands on piston rods and the piston rod collars while pump was in motion. The act of removing pistons from piston rods contributed to still other accidents. The installation of new liners accounted for a few injuries. The act of installing a new bull gear in a pump resulted in a severe injury. Contributing to other accidents were use of jacks to align pumps; installing pressure gauges; and being in dangerous relative positions to unguarded shear relief valves at the moment they opened.

"Shale Shakers" have not contributed a high frequency in accident occurrences, but those that have occurred have usually been serious. One of those serious types is for crewmen to let their hands follow a V-belt into a V-grooved sheave. The usual result is for a finger or hand to be badly mangled.

All V-belt drives should be properly protected with an enclosure type guard at all times.

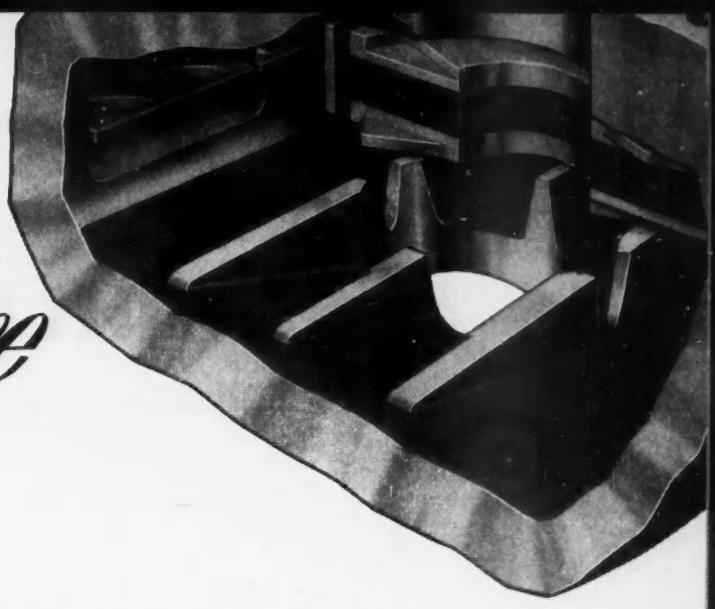
"Mud Treating and Conditioning," as a phase of the general practice, was involved in 11 accidents. Four of the resulting injuries were caused by caustic solution being splashed onto the handlers during the treating process. Three of the injuries occurred while conditioning mud pits with mud guns and jetting hose. The rigging of mud conditioning equipment such as mud guns and mixing hoppers accounted for three injuries.

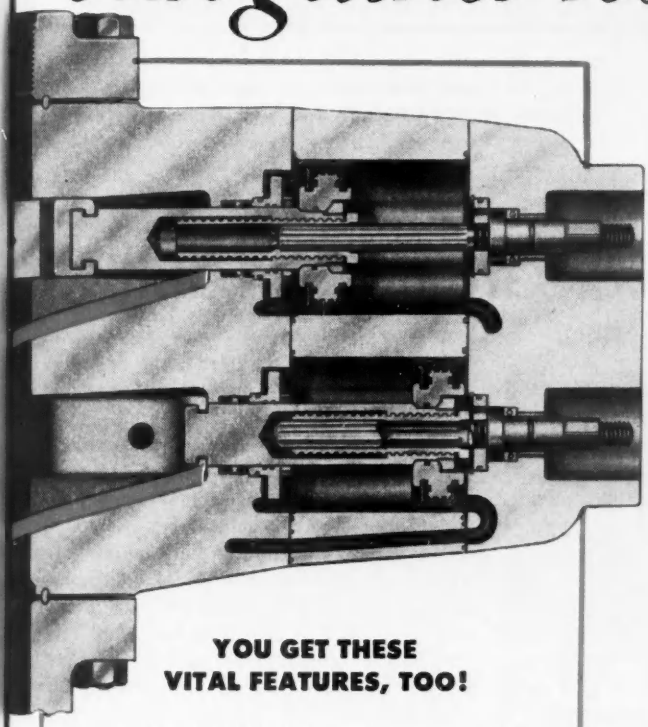
"Mud Line Rigging and Unrigging" mishaps were responsible for 13 injuries to rig crewmen. Slipping and falling on muddy ground; dropping pipe on feet; and falling when pipe wrench jaws fail to hold, contributed to some of the injuries. There, too, were several mis-hits with sledge hammers. The hammers hit the crewmen instead of the intended strike-point, thus causing injury. Several fingers were caught and severely mashed between the pipe sections being handled and adjacent objects.

"Mud Box Manipulating" acts contributed to three accidents. One crewman's fingers were severed as he allowed it to remain in the hinged opening on back of box as it was closed. The other two were minor bruises caused by closing box on fingers.

When crewmen are trained to think about avoiding what has happened during the performance of specific practices the resulting more alert thinking will lead to safer operations.

No mud-no sand *can gather here*





Unique self-draining feature prevents detrimental accumulations

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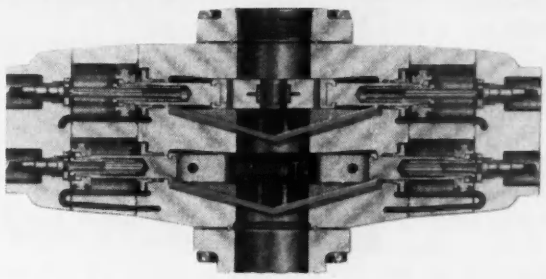

Besides its many other important features, the new Shaffer Hydraulic Cellar Control Gate incorporates an important advantage found in no other hydraulic cellar control gate. Note how the bottoms of each ram compartment are steeply-sloped toward the bore—*with high, narrow ribs upon which the rams travel.*

These ribs are *narrow* so as to reduce to a minimum the surface upon which any mud or sand can gather. And the little that does collect on these ribs is quickly and easily wiped off by the rams as they open or close.

In addition, because these ribs are *high* above the steeply-sloped bottoms of the gate, they hold the rams far above any mud or sand that might collect on the bottoms of the ram compartments.

As further protection, note how the bottoms have a steep inward pitch that quickly drains mud and sand back into the well as quickly as it settles. With this three-way protection against detrimental mud and sand, the rams are *always* ready for use whenever pressure emergencies threaten!

Then remember this—mud-free design is only one of *many* far-reaching advancements built into the new Shaffer Hydraulic Cellar Control Gates. Check over some of the others outlined at left. No other equipment provides so *much* protection—in so *small* a space—with so *many* operating advantages!

YOU GET THESE VITAL FEATURES, TOO!

▸ UNUSUAL COMPACTNESS —with *two* separate ram compartments unitized into *one* body having an over-all height of only 30 inches even in sizes as large as 13⅜" (12" Series 900). *Smaller sizes are even more compact!*

▸ DIRECT HYDRAULIC DRIVE —with the hydraulic operating cylinders *directly behind* each ram. For simplicity and maximum safety there are no secondary connections between hydraulic cylinders and rams!

▸ FAST RAM CHANGES —the simplest and fastest in *any* gate. Merely unbolt and swing open two side doors, slide out the ram assembly, change the ram blocks and rubbers, slide the assembly back in, close and bolt the doors—and the job is done. *Moreover, complete ram changes can be made whether pipe is in or out of the hole!*

▸ FULLY ENCLOSED DESIGN —with all moving parts enclosed and no moving parts on the outside to become wedged or damaged by objects falling into the cellar—or become corroded by chemical and salt drippings. Even the locking shaft is non-rising and fully protected!

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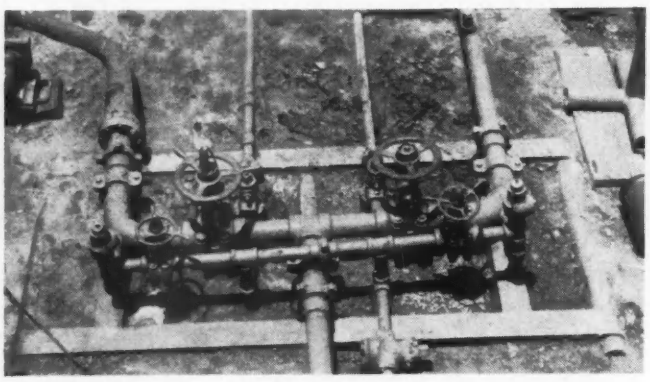
HOW TO—Manifold Mud Lines for Greater Flexibility

Elimination of wear and tear that accompanies making up and breaking out mud discharge valves and fittings was effected by this permanent skid-mounted manifold system. Time was saved as well in setting up the rig.



Discharged mud from two mud pumps is carried through flexible rubber hose. One flexible hose is connected to the manifold through the four-inch hammer union shown at left. The second pump discharges through a similar flexible hose tied into a four-inch lateral connected to the manifold by the hammer union shown at right. Each line connects into a long sweeping ell with a two-inch outlet. Mud valves placed in the line beyond the ells are joined with a tee fitting equipped with a short nipple, at the end of which is a third large hammer union. This line supplies mud to the standpipe on the rig.

The two-inch outlets from each sweeping ell are similarly equipped except that two laterals are added. These lines provide a means of placing pressure relief valves in the mud line on each pump discharge and make it possible for one pump to supply mud for the mud guns while the other circulates the drilling fluid. As shown, the pressure relief valves are added at the two-inch outlets, beyond which a two-inch mud valve is installed in the line. This two-inch line is joined by a hammer union, because it must be broken when the manifold is moved with the rig.

The assembly is skid mounted and held in place by pipe anchors bolted to the I-beam flanges on the skid. The unit is quickly placed in operation.

HOW TO—Set Up Mud Gun to Fight Oil Well Fires

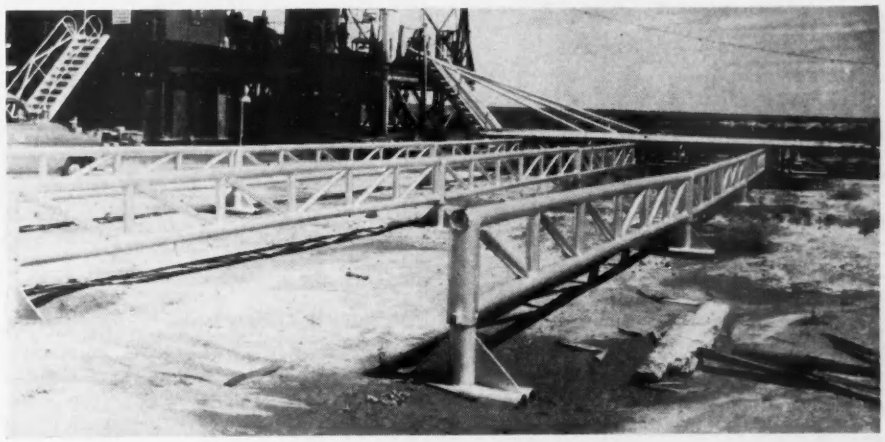
Past experience in blowouts and well fires has brought about strict rules and regulations in drilling operations. However, regardless of the preventive measures, adequate means must be provided to combat a fire should it occur. It is standard practice on many rigs to equip them with large carbon dioxide extinguishers. In addition to such standard practices, one contractor operating several power rigs set up an extra mud gun to be used in the event of a well fire. Drilling mud makes an excellent liquid in extinguishing flames, and if the fire is attacked immediately after starting, chances for overcoming it are greater.

The extra mud gun is located so that the mud stream can be directed on the blowout preventers, the drawworks and the engines. Because of the pressure available from the mud pumps, a stream of fluid can be forced several hundred feet away from the nozzle, and in large volumes.

In the rig shown, the three gas engines are connected to a power transmission through air clutches. One end of the transmission is connected to the drawworks while the mud pumps are driven from the other end. Even though one engine may be on fire, the others can be used to power the mud pumps to supply fluid for this mud gun extinguisher. A standby pump set off from the rig and used as an auxiliary unit can also be used. The two-inch line supplying the mud is tapped into the main supply line leading to the stand pipe. In this manner, the gun is assured a supply of mud under most circumstances when a fire is first started on the floor. Its location about 60 feet from the substructure is far enough away so the operator can direct the gun and not be burned by the flames.

HOW TO—Construct Heavy Duty Pipe Rack Units

Essential around any drilling rig, large or small, are the pipe racks where drill pipe can be stored and handled, and where casing can be unloaded awaiting use. There are many designs for pipe racks, and as many different layouts for this equipment at the rig. Pipe rack construction described here makes these individual units interchangeable and flexible in their erection.



These heavy duty pipe racks are in integral lengths of about 30 feet, and consist of salvaged 4½-inch drill pipe with the box and pin ends removed. The individual units are merely truss members made by welding two lengths of drill pipe to six-inch end pieces to form a long narrow rectangle. The top or upper drill pipe section is cradled in the 6-inch section and a lip weld made at either end to secure the drill pipe in place. The lower pipe member of the truss is simply welded to the lower part of the six-inch ends. Vertical braces of 4½-inch drill pipe are welded at distances of about five feet, with angle braces set between them to form a rigid truss.

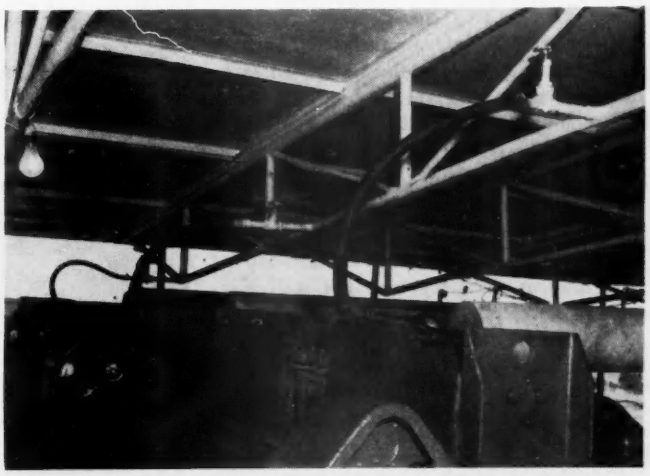
The abutting ends of each unit tie into adjacent units by a notch and plug design. In one end of the top truss member has been cut a notch, while the other end is fitted with a solid piece of bar steel. The lower end of the six-inch end piece is notched at one end of the unit while the opposite end has a welded plug of square bar steel. These notches and plugs on opposite ends of the integral units are made so they exactly match, and one unit can be combined with another unit by interlocking the end sections, thereby forming a smooth top surface for rolling pipe.

The stand which supports the truss member is a vertical section of five-inch pipe which telescopes inside the six-inch end pieces of the truss. This vertical member is approximately three feet high and is fitted with holes that match adjusting holes in the outer telescoping section. Such a design permits adjustments in height of the pipe rack should one support be in a low spot. The vertical support rests on two three-foot sections of pipe welded together to form a footing element. A web brace of plate steel adequately braces the foot pieces to the five-inch supporting pipe.

By equipping several rigs with this type pipe rack, these units may be interchanged as required, and they permit a flexible arrangement of the racks at any location. They are of adequate strength to support the heaviest drill pipe and largest casing.

HOW TO—Provide Engine Radiator Make-Up Water

Maintaining recommended operating temperatures of large and expensive internal combustion drilling engines goes a long way toward keeping the repair bill down. Among other important items, the cooling system must be kept full of water, or at least at safe working levels. The immediate availability of radiator make-up water is a considerable inducement in filling the cooling system when it becomes low. In hot, dry locations with engines operating continually, this must be checked frequently.



Here is a simple, practical way to supply make-up water for the drilling engine radiator. The water supply header which spans three drilling engines is actually part of a roof supporting truss. Water is supplied through the horizontal header located at the rear edge of the engine platform. A collar is welded into the truss member and a short nipple screwed into a globe valve. A rubber hose carries the water into the radiator as shown, and the discharge end of the hose remains in the fillup opening. A similar system supplies water to extinguish backfires in the engine exhaust pipe.

A small movable ladder on the far side of the engine, between the two engines in the foreground, enables the mechanic or crew member to check the water level periodically. While standing on the ladder, he can add the desired amount of water by means of the globe valve. This system is moved as a part of the roof and only a few connections need be made up or broken to make up and tear down the unit.

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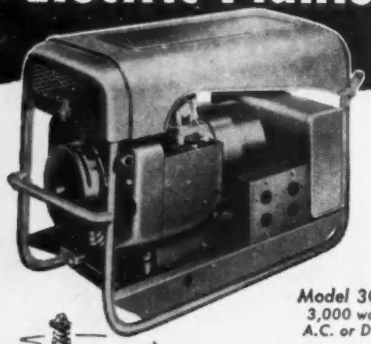

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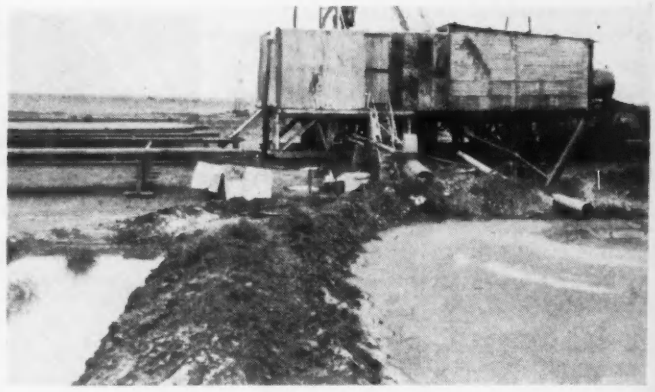
HOW TO—Conserve Drilling Water



Through the use of an improved mud handling practice, a West Texas drilling contractor is making more efficient use of scarce and costly drilling water, saving time and effort of crew members and reducing wear and tear on his shale shakers.

It is fairly common practice among operators in this area to circulate clear water in drilling down to a depth of around 6100 feet, the point at which gas shows of importance begin to occur. During the drilling of this first 6100 feet of hole, this contractor finds it desirable to bypass the shale shaker, extending his mud return line directly over to the main sump. Here, sand and cuttings have ample time to settle out as the water continues across the 60 feet of sump to the other end. From the other end of the sump, water is returned through a ditch ten feet wide and two feet deep, located parallel to and close beside the main sump. From here it is directed around to the mud mixing ditch. In the photograph, which was taken looking toward the rig from the distant end of the main sump, can be seen part of main sump and shallow return ditch.

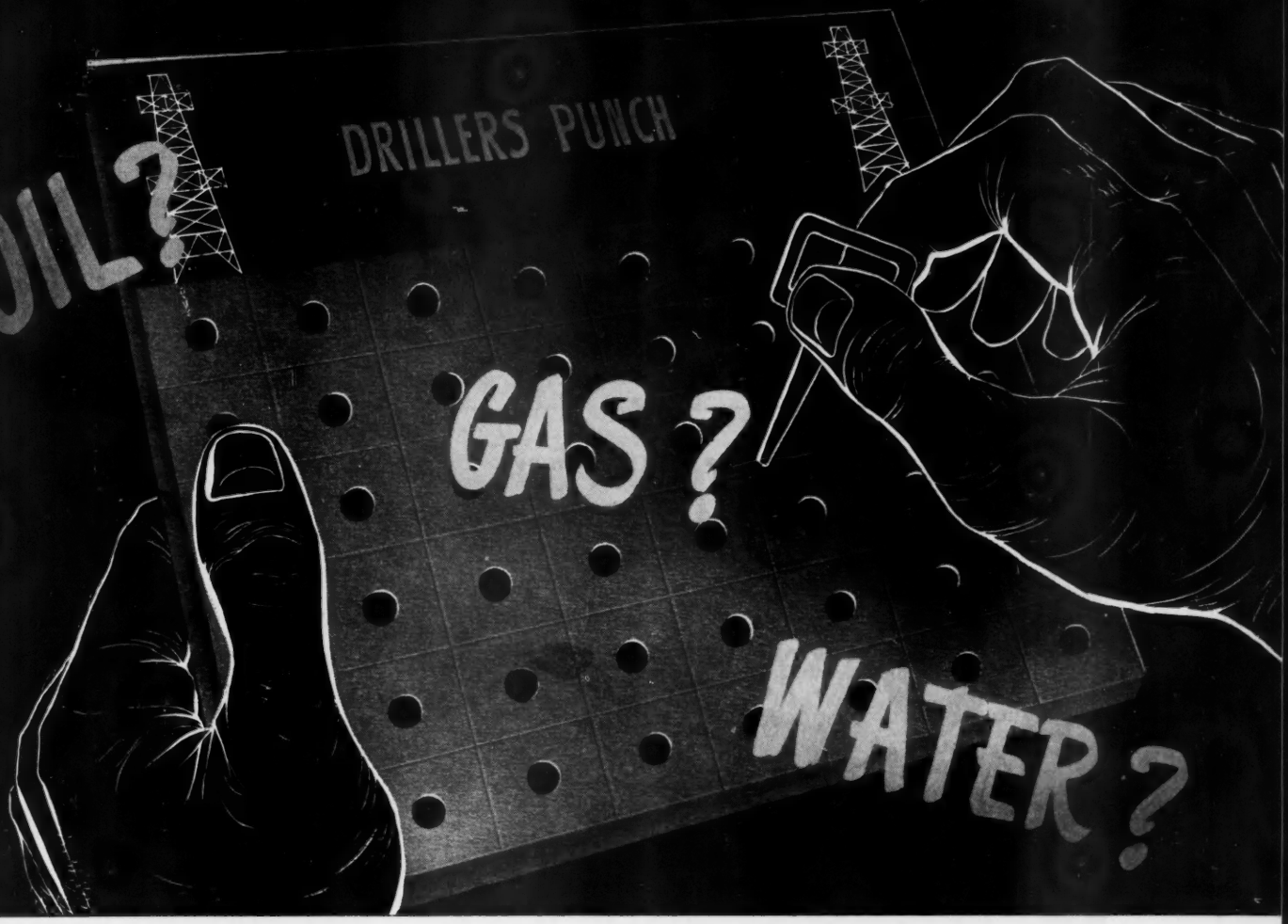
In bypassing the shale shaker and al lowing cuttings to settle out in the waste sump, the contractor eliminates the need for jetting cuttings over into the sump, an operation that requires considerable water and extra work on the part of the crew. The only extra cost involved in the present system is in cutting the extra ten-foot wide return ditch. This cost is comparatively slight, however, for the shallow cut can be done quickly by an experienced dozer operator. The shale shaker is placed in operation and used in the conventional manner when the bit reaches the critical depths where it is necessary to mud-up.

HOW TO—Take Off Cutting Samples

Of particular value to the geologist or engineer is an efficient method of taking off cuttings from the mud flow line at a point midway between the well head and the shale shaker. In this installation, a 2-inch coupling is welded to the under side of the line and into this coupling is screwed an ordinary drum-type spigot. The peeling-off action of this type of valve makes it particularly suitable for cutting off the flow of sand- and cuttings-laden fluid, and at the same time has sufficient opening to enable a man to obtain a good sample of the cuttings in minimum time.

The installation is easy to make and can be applied to nearly any type of mud ditch. When the rig equipment is moved to a new location the spigot is unscrewed to prevent its being damaged during the loading and unloading operations. A small ditch leading to the mud ditch carries off fluid that spills over the sample collector.

WHICH WILL IT BE ?



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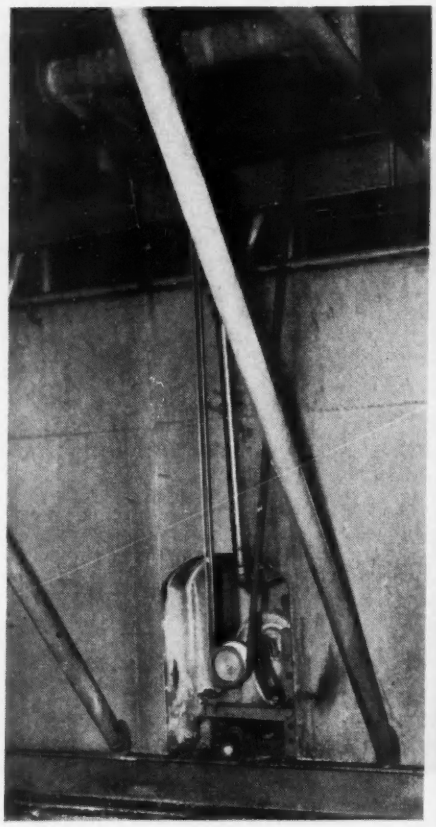
HOW TO—Mount Washdown Pump in Tank Recess

In arid areas such as New Mexico and West Texas, it is necessary to provide storage tanks at the drilling rig to maintain a "working" volume of water on hand at all times. In addition to a 500-barrel cylindrical tank mounted on skids, the space below the engines in the engine substructure is utilized for tank space. Sheet metal welded to the inside of the substructure forms a rectangular tank for the storage of water.

One of the interesting features of this tank arrangement is the manner in which the washdown pump is mounted. During the construction of the tank, it was not difficult to weld an arched recess extending into the tank compartment as shown. The recess is large enough to accommodate the small centrifugal washdown pump, with ample head room for making connections and bolting the pump down to an angle iron foundation. The foundation is merely an inverted "U" section welded to the skid runner at one end and to bottom sheet plates at the far end.



The recess installation protects the washdown pump not only during rig moves, but during normal drilling operations. By setting the pump inside this recess it is amply protected, and in such a permanent setting only a few easily-made connections are required.

Drive arrangement of this washdown pump is interesting, also. The pump is set in the tank recess just below the main drive shaft from the power transmission. A three-groove V-belt pulley mounted on the end of this shaft transmits power to the smaller pulley mounted on the centrifugal pump. As long as the transmission is engaged, this pump is in operation. And, being a centrifugal pump, no damage is done by operating the pump against a closed discharge, as would be the case when the washdown hose is shut off.

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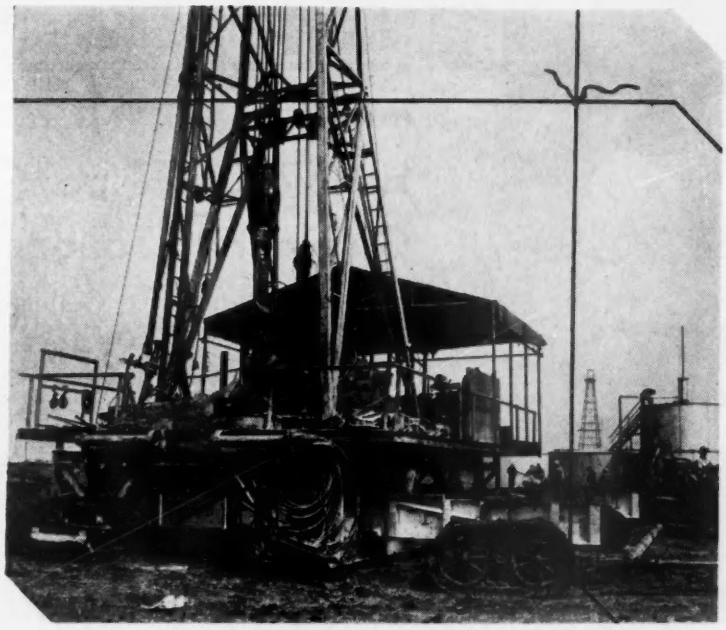

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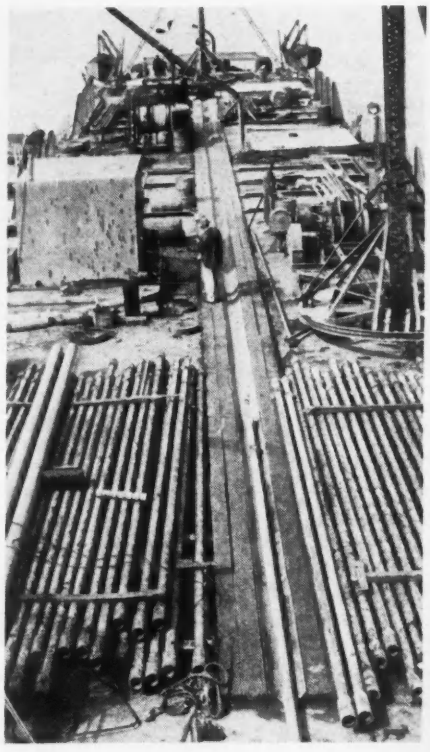
HOW TO—

Handle Drill Pipe On Floating Tender



Unless additional space is provided on an offshore drilling structure to accommodate the storage of equipment, reserve mud, cement and pipe, a floating tender must be used. Because it is extremely costly in most cases to provide extra platform space for such items, it has been found more economical and equally practical to provide a floating barge, or tender as it is sometimes called.

Storage for drill pipe and casing on the tender illustrated is provided on the upper deck both forward and aft where cranes are located for loading and unloading. Adequate means for handling the pipe from the tender up to the derrick floor is on the deck. A steel trough extending down the middle of the drilling tender from one end of the far pipe racks to those shown in the foreground is used for this purpose.

For the protection of the steel barge decks as well as for the protection of pipe handled, a piece of used casing was split down the side and bent open. Several joints of such casing were necessary to span the distance between pipe racks, and each was welded to the other and the resulting joint ground down to form a smooth surface.

Heavy timber planks, 3x12-inch pieces, were laid alongside the steel casing trough

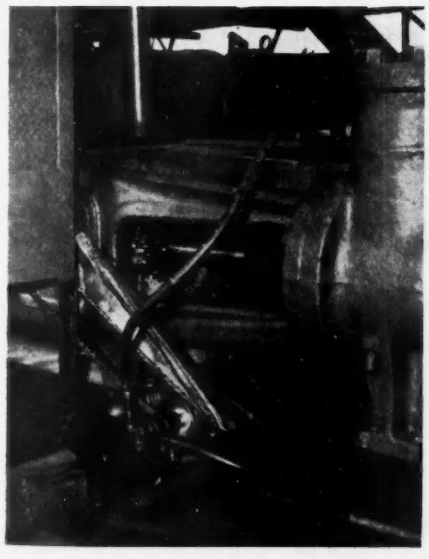
and butted against the timbers on which the pipe was racked. This arrangement makes it easy to roll the pipe from the rack into the steel trough where a line can be attached to the joint of pipe and transferred to the derrick floor. Pipe and casing can be handled easily and safely in this manner. The trough forms no stumbling hazard and is simple to install.

HOW TO—

Connect Up Rod Lubricating Pump

Many new and different ideas pertaining to the lubrication of slush pump piston rods have been presented in issues past. Several unusual features are used in this installation.

A small gear-type pump transfers lubricating oil from a sump below the pump housing up to a point above the rods where the oil drips over the rods where they enter the packing glands on the fluid end. The tiny pump is mounted on a piece of flat plate steel bolted to the top web of the I-beam skid. The pump is driven by a wedge belt fitting over a small pulley attached to the pump. The belt rides over the main drive shaft where it is exposed

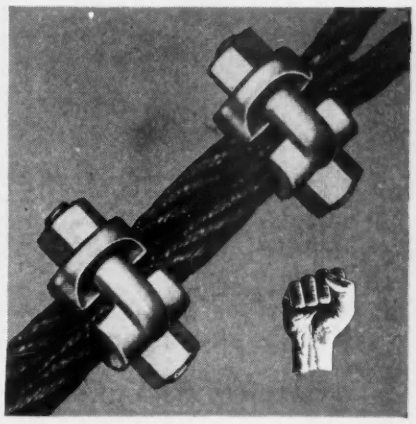


between the large pump flywheel guard and the shaft bearing housing.

A piece of two-inch pipe extending across the mud pump just below the housing around the rods serves as an oil sump. Drain holes in the housing members empty into the sump which is fitted with a bull plug on one end for cleaning.

Flexible oil-resistant rubber hose is used for suction and discharge lines from the lubricating pump. The discharge line connects to a ¾-inch pipe extending across the top of the pump housing directly above the fluid end packing glands.

You can SEE the difference!



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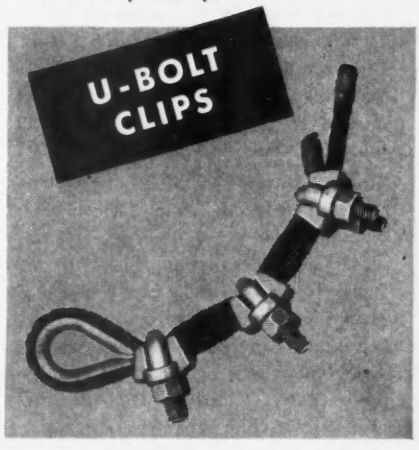

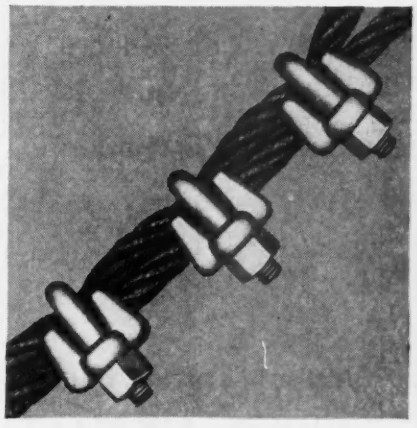

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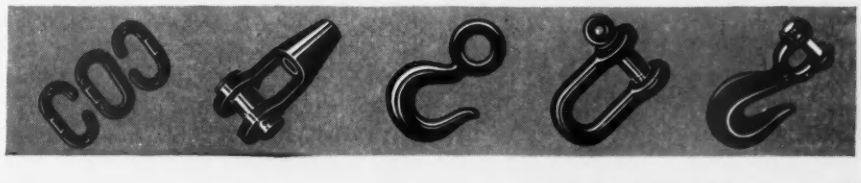

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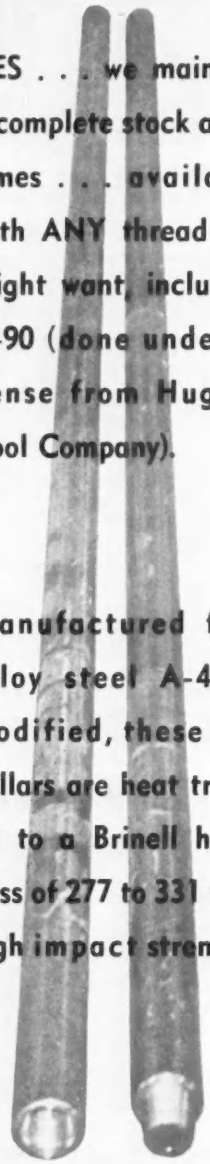

Manufactured from alloy steel A-4142 modified, these drill collars are heat treated to a Brinell hardness of 277 to 331 with high impact strength.

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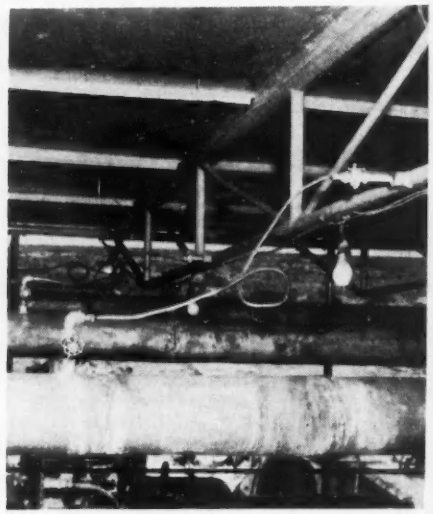
HOW TO—Extinguish Exhaust Flame

Internal combustion engines provide flexible power for the drilling rig, but unless precautions are taken they can form a serious fire hazard. One fire hazard is the exhaust. When drilling through gaseous zones and explosive mixtures are present around the rig, a sudden backfire of the exhaust may start a serious well fire.

In combating this situation, many rigs are equipped with flame arrestors, while regular open-end exhaust pipes having no muffler are fitted with a tap in the exhaust where water is constantly sprayed into the exhaust gases. Pressure in the line forces water out the exhaust which is tilted downward slightly from the engine manifold to prevent water from entering the engine when it is not operating.



Supply water for flame arrestors on three large gas engines is carried through a tubular roof truss mounted across the engines and transmission. The truss is fabricated from 1¾-inch water pipe. Each end of the truss member is supported by a horizontal header which rests on vertical risers. One riser, near the corner of the engine platform, connects into the rig water supply. The other risers are blanked off, as are the remaining truss members.

A coupling welded into the water-carrying truss is fitted with a short nipple and valve. A reducer connected into the downstream side of the valve carries a ¼-inch piece of copper tubing attached to the exhaust line fitting. By utilizing the truss, no additional piping was required to supply the exhaust flame arrestor with water.

HOW TO—Provide Safety Footing

Even though a non-skid surface has been laid on the floor covering the drill pipe rack (in this case used catline interwoven with discarded drilling line), the floor becomes so covered with mud draining from the pipe that great hazard exists. Especially while going in the hole, when mud drains out and accumulates on the pipe rack floor, the floorman must have a steady footing to counteract the force of the thribble of drill pipe as it is lifted from the floor prior to making it up on the drill string.

This simple non-skid mat provides the floorman with solid footing when easing a thribble into makeup position, even though the mud is as much as half-inch deep. The mat, measuring about 18 inches wide by 24 inches long, is made of expanded metal welded to an angle iron frame. It is light enough to be shifted as required when rows of pipe are placed back in the hole. The angle iron frame raises the expanded metal mat ¾-inch off the floor. It is long enough to be of use in handling the nearest or farthest stand of pipe in any one row. Such a safety device eliminates the frequent washdowns that would be necessary if no such aid were employed.

NORTH COWDEN FIELD

Gas Injection Project

By M. H. RAHMES
Stanolind Oil and Gas Company

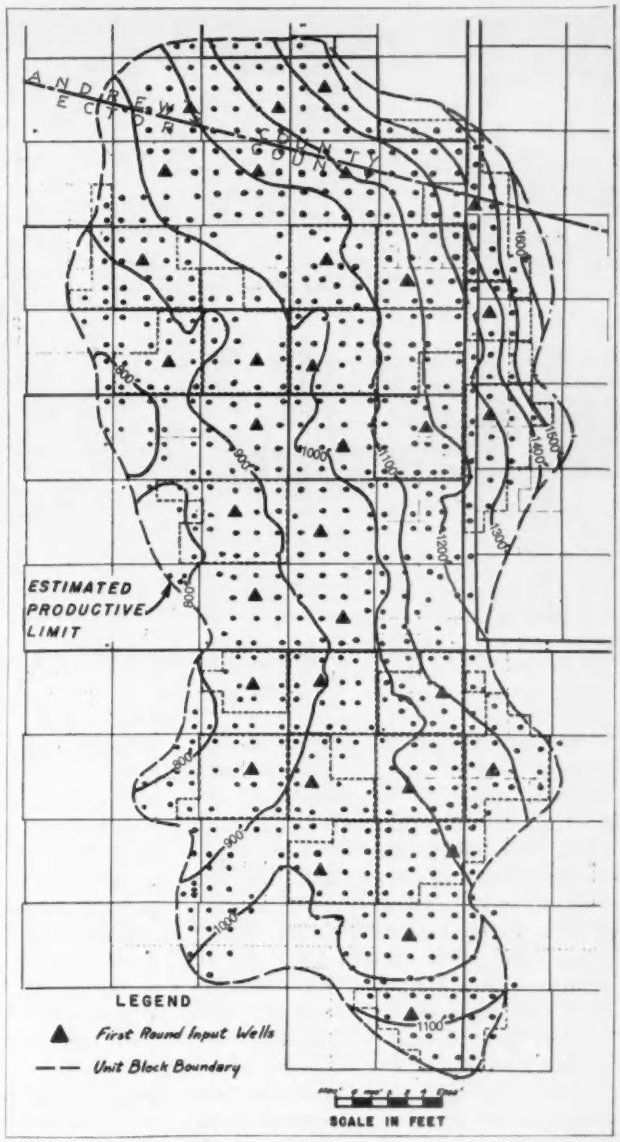


Figure 1. Contour lines and estimated productive limits of the North Cowden field are shown by this map.

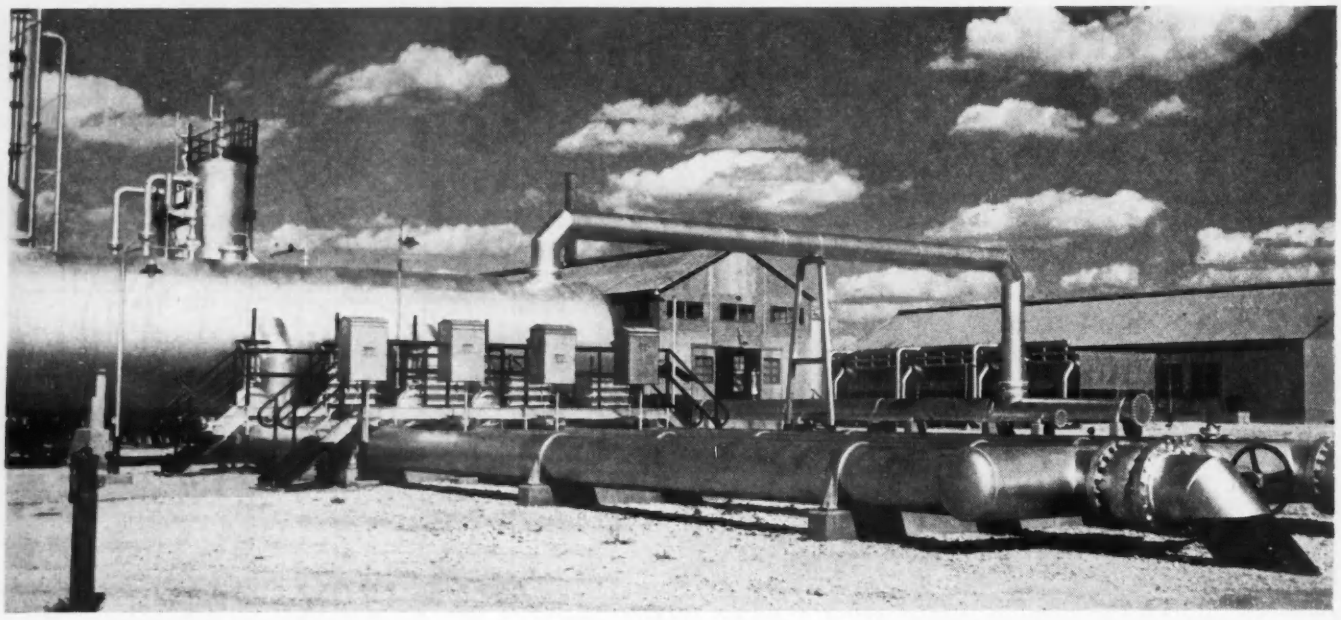
ONE of the largest cooperative gas injection projects ever inaugurated has been placed in operation in North Cowden field, Andrews and Ector counties, Texas. In order to carry on gas injection, it was necessary to construct a large high-pressure gasoline and injection plant. The new plant was put in operation April 14, 1950, and the first injection of gas commenced on May 5, 1950. This project has the dual purpose of increasing ultimate oil recovery from the Grayburg formation and permitting the processing of all gas produced from the field. Benefits from the standpoint of conservation of natural resources can be measured two ways: ultimate oil recovery will be materially increased and substantially all the liquid hydrocarbons will be recovered from the gas prior to its reinjection into the formation.

The North Cowden field lies across the line between Andrews and Ector counties about 25 miles west of Midland, Texas. Discovered in October, 1930, active development was not begun until 1934. By 1941, development of the field was essentially completed. The field covers about 27,000 acres on which 680 producing wells have been drilled on 40-acre proration units. Approximately 7900 acres were initially underlaid by gas-cap. Cumulative oil production at the end of 1949 approximated 79 million barrels. The oil is "West Texas sour," having approximately 1.78 percent sulfur by weight and an average 32-degree gravity at 60° F.

MAINTAINING reservoir pressure by injecting gas into the formation not only conserves valuable natural gas, but also increases the recovery of liquid hydrocarbons. Here is a brief introduction and description of one of the largest cooperative gas injection projects in the country. Involving 21 operators, the North Cowden pressure maintenance program and natural gasoline plant commenced operations on April 14, 1950.

The producing zone is the Grayburg formation of Permian age. Oil pay near the crest of the structure is topped at approximately 4100 feet. The gross thickness of original gas saturated section in the gas-cap area averages 55 feet, while the average gross oil saturated interval approximates 90 feet. The pay consists of sand and dolomite near the crest of the structure, grading to pure dolomite on the east flank. The structure is an elongated anticline with the major axis trending northwest-southeast. The structure has about 800 feet of relief between the crest and the down-dip limit of production. Figure 1 shows general structural conditions.

The North Cowden Grayburg reservoir has operated predominantly under an internal gas expansion drive. No effective water drive is present, although a small amount of water



Gas enters the plant at this large horizontal scrubber after first passing through four 26-inch meter runs where the gas is measured at about 7 psig pressure.

(400 barrels per day) is produced around the periphery of the field. Original reservoir pressure was approximately 1800 pounds per square inch. As is characteristic of this type of reservoir, pressure has declined continuously and had reached a value of 727 psi by December, 1949. Originally, 562 cubic feet of gas were in solution in a barrel of residual oil near the top of the structure, with smaller quantities in solution near the down-dip limit of the field.

The cooperative gas injection program has been carried out by dividing the field into injection blocks of approximately 640 acres each. This was done to expedite the gas injection program because it was evident at an early date that lengthy negotiations would have been required to form a field-wide unit. To date, 33 such injection blocks have been formed, comprising a total of approximately 20,500 acres. The project is starting out with one injection well in each block, as shown in Figure 1. Ultimately, it is expected to have a minimum of two injection wells in each block. Thirty-two oil operators who own 80 percent of the developed acreage in the field have joined in the program. The opportunity to enter the program is still open to the royalty and working interest owners in the field who have not yet joined.

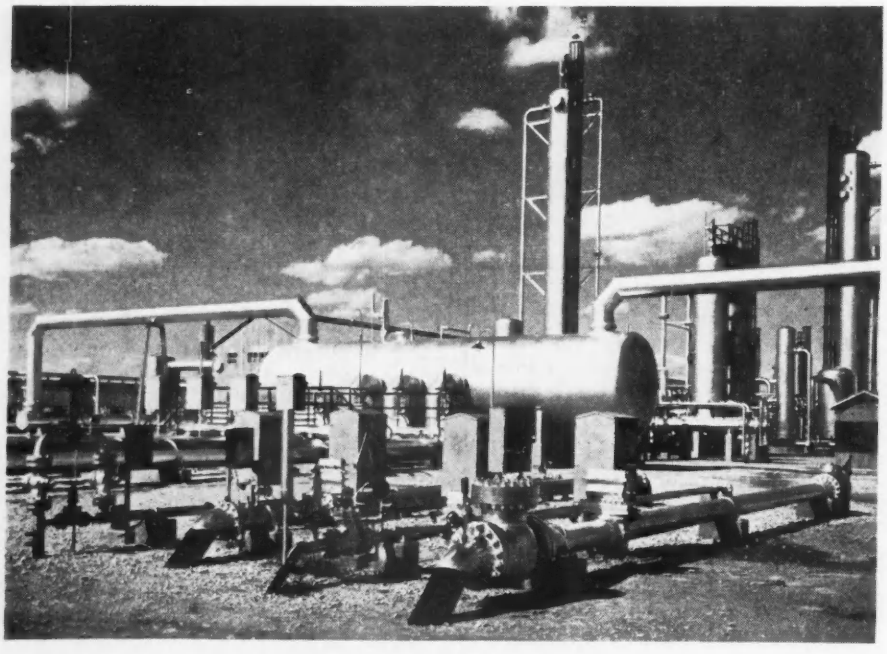
Present plant capacity is 50 million cubic feet per day, but the plant is designed for ultimate enlargement to 100 million cubic feet per day by adding to compressors, heat exchange equipment and utility features, and by paralleling certain process services.

The plant is designed for 60 percent propane recovery and essentially 100 percent recovery of butanes and heavier. Liquid products, when processing 50 million cubic feet of gas daily, are expected to total 150,000 gallons per day.

Process features include monoethanolamine sweeting of gas and condensate after the second stage of compression, oil absorption at 700 pounds per square inch gauge, solid desiccant dehydration of residue gas and compression of residue gas to 1700 psig for injection.

Field gas is gathered from 171 batteries at a maximum gathering system pressure of 10 psig. Gas enters the plant through four meter runs.

The compressor installation consists of ten 1600 horsepower units installed in two compressor houses. The five compressors in one building are equipped with three stages and discharge at 717 pounds per square inch gauge. The five compressors in the second building are equipped with four stages, the first three stages paralleling the corresponding stages of the three-stage machines, and the fourth stage serving to compress residue gas to 1700 psig for injection. Each group of compressors has a separate closed jacket water system with air cooling of the water.



Residue gas at 1700 psi and at 190° F. is distributed to injection wells from the plant discharge line shown at right. Other lines at left carry dry gas sold to transmission lines, as well as for field use.

Gas Lift

Principles and Practice

Part 4—CONCLUSION

By C. D. FLETCHER

Sales Manager, Merla Tool Corporation

FLOW by aeration consists of aerating a column of fluid, by injecting gas, to lower the flowing gradient of a fluid column to a point at which the weight of the fluid column from the point of injection to the surface is less than the flowing bottom-hole pressure at the point of injection. This permits the energy of the flowing bottom hole pressure and the result of an aerated, lengthened fluid column, to deliver fluid to the surface.

The valves presently used in this operation are divided into two classes, automatic differential and pressure controlled continuous flow valves. These types differ distinctly in their construction and operation. Methods of control govern the manner in which gas is injected into the tubing from the casing annulus. The principle of this type gas lift operation, regardless of the valve used, is essentially the same.

Valves for differential operation are usually designated as automatic differential valves because their opening and closing is automatic according to the differential existing between the casing annulus pressure and the weight of fluid in the tubing above the point of the valve in the string.

Although there are several methods of constructing valves of this type, basically their operation is the same. Automatic differential valves are usually constructed with a piston, valve, valve seat and tension spring (Figure 15). The downstream side of the valve seat is exposed to the weight of fluid in the tubing above the point of the valve in the string and the upstream side of the valve seat is exposed to the casing annulus pressure.

The tension spring is placed so that it tends to hold the valve open. This spring tension, in relation to the cross-sectional area of the valve piston and valve seat, controls the amount of differential by which the valve operates. The amount of differential, predetermined and set by the spring in the valve assembly, remains constant. Practices have proved a 100- to 125-pound differential to be the most efficient.

When the casing annulus pressure acting upon the cross-sectional area of the valve piston becomes sufficient to overcome the tension of the spring, the valve closes. When the weight of fluid in the tubing above the point of the valve in the string, acting upon the cross-sectional area of the valve seat, is slightly more than the casing annulus pressure minus the tension of the spring, the valve automatically opens.

It is evident that when the valve is open, there is slightly less than the set valve differential existing between the casing annulus pressure and the tubing back pressure. This differential is necessary to permit gas to enter the tubing, aerate and lower the fluid gradient, and assist in delivery of fluid to the surface.

As long as the existing differential, at the point of the valve in the string, is less than the set valve differential, it will remain open and continue the injection of gas into the tubing fluid column. When the injected gas lowers the fluid column gradient to a point where the total weight of the fluid column, from the point of the valve in the string to the surface, creates a differential across the valve greater than the set valve differential, the casing annulus pressure acting upon the cross-sectional area of the valve piston overcomes the spring tension and the valve closes.

This valve should be operated with a minimum of surface back pressure, which creates an artificial differential across the valve, thereby reducing fluid production in proportion and decreasing the installation efficiency.

If a well condition is such that the flowing bottom-hole pressure will feed past the point of injection at a rate sufficient to maintain a low differential across the valve, the operation of the installation may be continuous or a slightly "heading" type of flow will result.

Should a condition be such that the flowing bottom-hole pressure at the point of injection is insufficient to maintain a low differential across the valve, the valve will open and close automatically as often as the required differential pressure exists across it. When this condition occurs, the operation of the installation will closely resemble intermitting action, and the well will produce by periodic "slugging" heads. When the valve has sufficient gas volume passage, this operation is satisfactory if not attempted beyond the maximum operating depth of equipment and casing annulus pressure.

Continuous Flow Valves

Construction and operation of continuous flow valves differ from automatic differential valves in that continuous flow valves are controlled by the casing annulus pressure. It is possible to control their operation from the surface more closely than is possible with automatic differential valves. Continuous flow valves are set to operate at predetermined opening and closing pressures. Their operation resembles a back pressure, throttling type regulator.

Construction of this valve is similar to the pilot section of the intermitting valve previously described (Figure 16). By placing a choke immediately downstream from the valve seat, the closing pressure remains constant because the valve has no pressure differential across the valve seat; the pressure differential occurs across the choke. The opening pressure of the valve is a straight line function of the amount of back pressure against it. This back pressure is created by the weight of the fluid column in the tubing above the point of the valve in the string.

The chokes are sized to control the volume of passage through the valve when it is open, and the size of the chokes is usually increased slightly as the valves are positioned lower in the hole.

This valve operates in accordance with characteristics of a spring, in that a spring compresses proportionately to the force applied against it. For example, after the valve is opened, if the casing annulus pressure is maintained slightly above the closing pressure of the value, the valve will be a proportionate distance off the valve seat and

pass a volume of gas accordingly.

The higher the casing annulus pressure maintained above the closing pressure of the valve, the higher the valve rises off the valve seat and the greater the differential across the choke. It is therefore evident that by controlling the casing annulus pressure and differential across the choke, gas volume passage through the valve is controlled and maintained. This control, for continuous flow operation, can be held at any point necessary to produce a well at the most efficient rate.

Continuous flow valves operate more efficiently against surface back pressure than automatic differential valves because, by controlling the gas volume passage and differential across the valve, they can be adjusted to counteract the surface back pressure condition.

Aeration Flow Analysis

Let us analyze the automatic differential and continuous flow type of gas lift practice, the limit as to operational depth, and the type of well in which it is most efficient. The principle of an aerated fluid column will be used.

In automatic differential flow, the valves are governed in their operation by the differential existing between the casing annulus and tubing pressures. As motion of fluid is maintained in its delivery to the surface, back pressure occurs under the fluid and against the valves above the operating valve. This may be sufficient to open the valves as the fluid passes en route to the surface particularly the valves next to the operating valve.

Conditions may be such that at times most of the valves in a string are open and injecting gas. Should too many valves be run in a string and this condition occur, the excessive volume of gas in the tubing creates a back pressure aggravated by friction. It then becomes difficult to create a differential across the valves sufficient for their closing action.

With the continuous flow valve, it is rarely possible that this condition will occur because the closing of the valves is controlled by the casing annulus pressure. With this control, the upper valves can be closed and remain closed during the operation of the installation.

It is recommended that these valves be used only in wells having a high bottom-hole pressure and high fluid productivity. As a rule of thumb, it is not recommended that this operation be used where the working level is below 4000 feet.

With both automatic differential and continuous flow operations, the amount of casing annulus pressure is of major importance. In the automatic differential operation, it is usually obtained by experimenting with various annulus pressures until the operation of the installation is satisfactory.

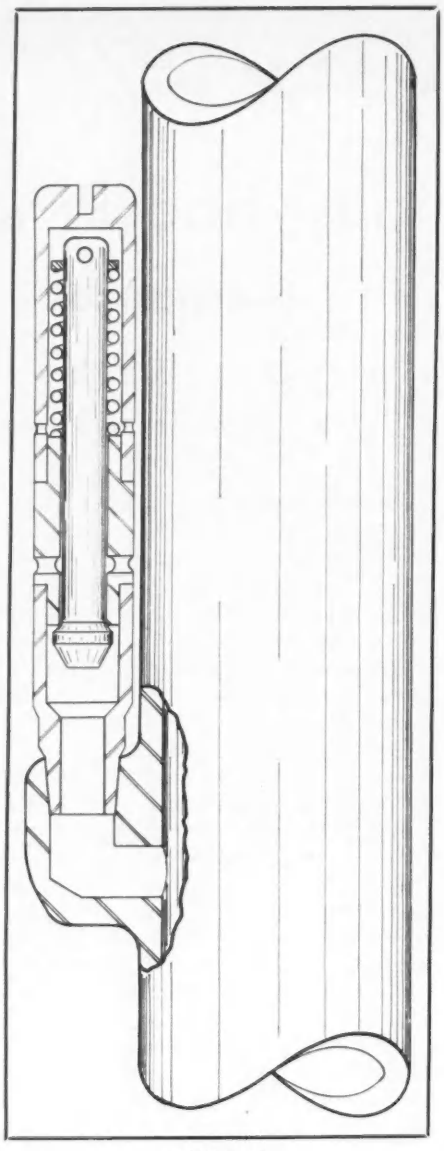


FIGURE 15

If the annulus pressure is too high it might be impossible for the bottom-hole pressure of the well to support a fluid column above the operating valve to a point where the back pressure would be sufficient to open the valve. The annulus pressure should be regulated and controlled to meet the individual well characteristics most efficiently.

In the continuous flow type of operation, selection of predetermined operating pressure is important. Bottom-hole pressure, productivity index and the estimated lowest possible tubing column flowing gradient are important factors. They are fully discussed in another part of this article.

A factor to consider in any aeration operation is the result of excessive operating pressure. When higher pressures are used in an attempt to work lower in the hole, admission of additional gas lowers the flowing gradient of the tubing fluid column beyond a point of efficiency.

When this exists, a reduction in quantity of fluid lifted occurs because friction loss in the tubing creates back pressure to a point where the flowing bottom-hole pressure is raised rather than lowered. This tends to reduce the differential between reservoir pressure and flowing bottom-hole pressure, thereby reducing the quantity of fluid flowing into the well bore.

Maximum Operating Depth

In computing the maximum operating depth for an aerating type of flow, the governing factor is the minimum efficient flowing gradient that can be established in the tubing fluid column. According to individual well characteristics, this might vary from 0.10 to 0.30 pounds per square inch.

The following equation is suggested for calculating the maximum operating depth for this type operation:

$$(10)\quad OD = \frac{CP - D}{FG}$$

Where:

OD = Maximum operating depth in feet from surface
CP = Casing annulus pressure, psi
D = Valve differential, psi
FG = Estimated fluid column flowing gradient, psi, per foot of height.

For example: a 500-pound casing annulus pressure, 100-pound differential and an estimated flowing gradient of 0.15 psi, the limit of operation as to depth would be:

$$\frac{500 - 100}{0.15} = 2666 \text{ feet}$$

Whether the column of fluid is equally aerated from the point of injection to the surface or broken up into small solid fluid heads and pockets of gas, the total weight of the column from the point of injection to the surface is the governing factor.

Point of Injection

To determine the lowest point of injection required to produce a desired amount of fluid, the following equation is suggested:

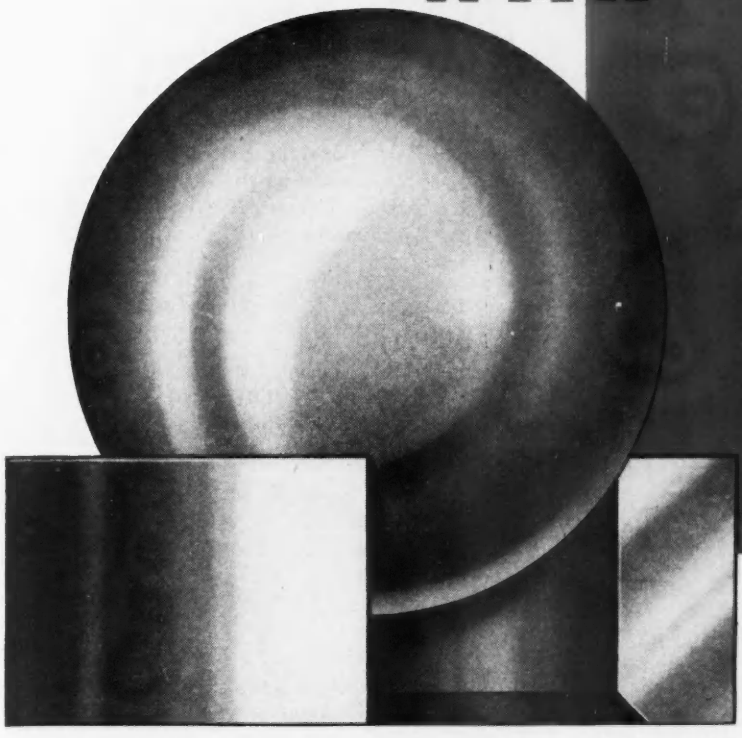
$$(11)\quad (FG)(X) + SG(TD - X) = BHP - Y$$

Where:

X = Distance in feet from surface to point of injection required for desired fluid production
FG = Estimated flowing gradient of fluid column from point of injection to surface, psi, per foot of height
SG = Static fluid gradient in the tubing from point of injection to the bottom of the hole, psi, per foot of height
TD = Total depth of well in feet
BHP = Static bottom-hole pressure, psi

Troubled with

- corrosion?
- abrasion?
- ball pound?
- high pulling cost?



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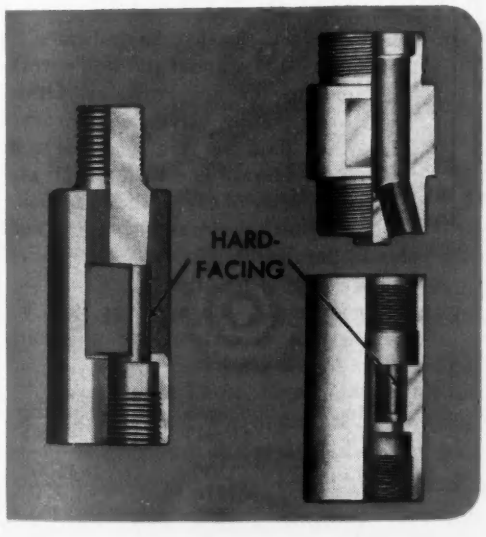

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Y = Difference in psi, between the static bottom-hole pressure and flowing bottom-hole pressure required to produce the desired amount of fluid.

For example: It is desired that 1000 barrels per day total fluid be produced from a well 5000 feet deep with a static bottom-hole pressure of 1600 pounds and a productivity index of 5, static fluid gradient 0.40 psi, estimated flowing fluid gradient 0.20 psi. With the P. I. of 5 and the desired production 1000 barrels per day, the static bottom-hole pressure must be lowered, $1000 \div 5 = 200$ pounds, to produce the required fluid.

The equation would read:

$$(0.20)\ (X) + 0.40\ (5000 - X) = 1600\# - 200\#$$

$$(0.20)\ (X) + (2000) - (0.40)\ (X) = 1400\#$$

$$(0.20)\ (X) - (0.40)\ (X) = 600\#$$

$$(0.20)\ (X) = 600\#$$

$$X = \frac{600}{0.20} \text{ or } 3000 \text{ feet}$$

Therefore, by automatic differential or continuous flow operation if sufficient gas were injected into the tubing at a depth of 3000 feet to reduce the flowing gradient of the fluid column to 0.20 psi from that point to the surface, a total fluid production of 1000 barrels per day would result.

Spacing of Top Valves

Spacing of the top valve from the surface is in accordance with the static fluid level in the well and available surface operating pressure. When the static fluid level is at or near the surface, the spacing of the top valve from the surface is:

$$(12) \quad S = \frac{P - D}{G}$$

Where:

S = Spacing from surface in feet
P = Available surface operating pressure, psi
D = Differential in valve psi, usually 100 psi
G = Static fluid gradient, psi per foot of height

For example: with 500 pounds available surface operating pressure and a fluid gradient of 0.40 psi, the top valve would be spaced:

$$S = \frac{500 - 100}{0.40} =$$

1000 feet from the surface.

Where the static fluid level is at such depth that available operating pressure is less than that required to balance a column of fluid equal in height the distance from the surface to the static fluid level, the ratio of the annulus and tubing areas must be taken into consideration. Under these conditions, the equation for spacing the top valve from the surface would be:

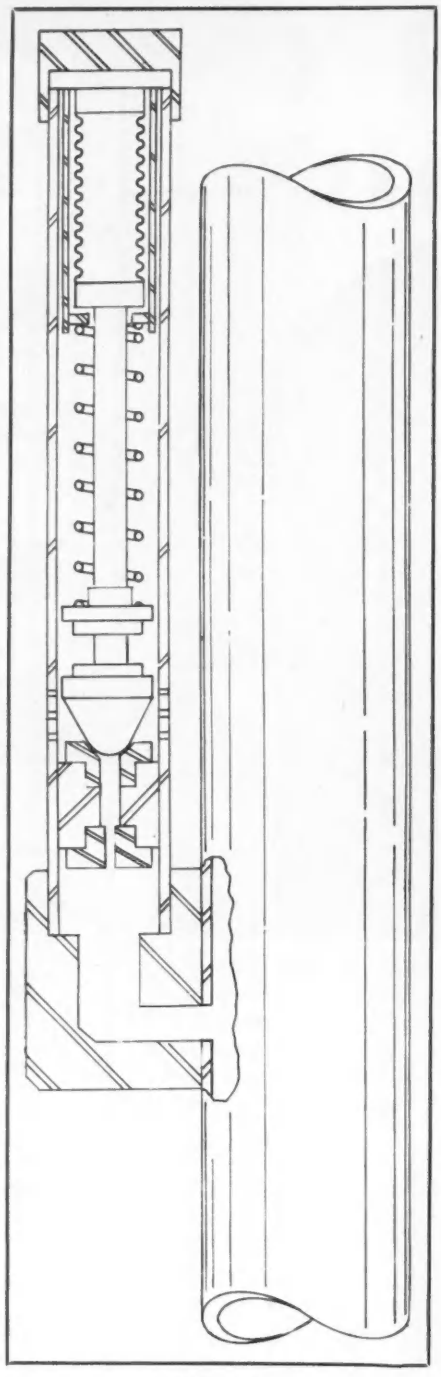

FIGURE 16

$$(13) \quad S = SFL + \frac{P - D}{G \times (1 + R)}$$

Where:

S = Distance in feet of first valve from surface
SFL = Static fluid level from surface in feet
P = Available surface operating pressure, psi
D = Differential in valve psi, usually 100 pounds
G = Static fluid gradient, psi per foot of height
R = Ratio of annulus area to tubing area

For example: with 500 pounds available surface operating pressure, a static fluid level 1500 feet from the surface, fluid gradient of 0.40 psi, well equipped with 5½-inch OD 14-pound casing and 2-inch EUE tubing, (ratio 4.9 to 1), top valve in the string would be spaced:

$$S = 1500 + \frac{500 - 100}{0.40 \times (1 + 4.9)}$$

or 1670 feet

Spacing Between Valves

In computing the spacing between automatic differential valves, the following equation may be used:

$$(14) \quad S = \frac{D}{G}$$

Where:

S = Spacing between valves in feet
D = Valve differential, psi
G = Static fluid gradient, psi per foot of height

For example: with 100 pounds differential in the valves and a static fluid gradient of 0.40, the spacings would be:

$$S = \frac{100}{0.40} \text{ or } 250 \text{ feet}$$

Spacings of automatic differential valves are usually by the closest possible full tubing joint lengths; thus, above spacing would be 8 joints of R-2 tubing.

Certain departures from this formula are possible. The top valves in a string of automatic differential valves can be spaced wider by 25 per cent more than the formula indicates, provided one is certain the working level is down the hole. The bottom valves in a string should be set closer than indicated, if there is any doubt about the well's working down to the bottom valve. Otherwise, the operating valve might produce insufficient fluid yet the next valve be difficult to operate due to the high productive capacity of the well at that point. Aside from these cases, the formula should be closely followed if efficient operation is to be attained.

For example: the spacings in a six-valve string of automatic differential valves might read as follows:

Value No.	Depth (Feet)	Spacing (Feet)
1	1500	1500
2	1770	270
3	2010	240
4	2250	240
5	2460	210
6	2640	180

Spacings between continuous flow valves are based on operating valve pressures and fluid gradient. The following equation may be used:

$$(15) \quad S = \frac{(CP - 25\#) - (DVA \times FG)}{SFG}$$

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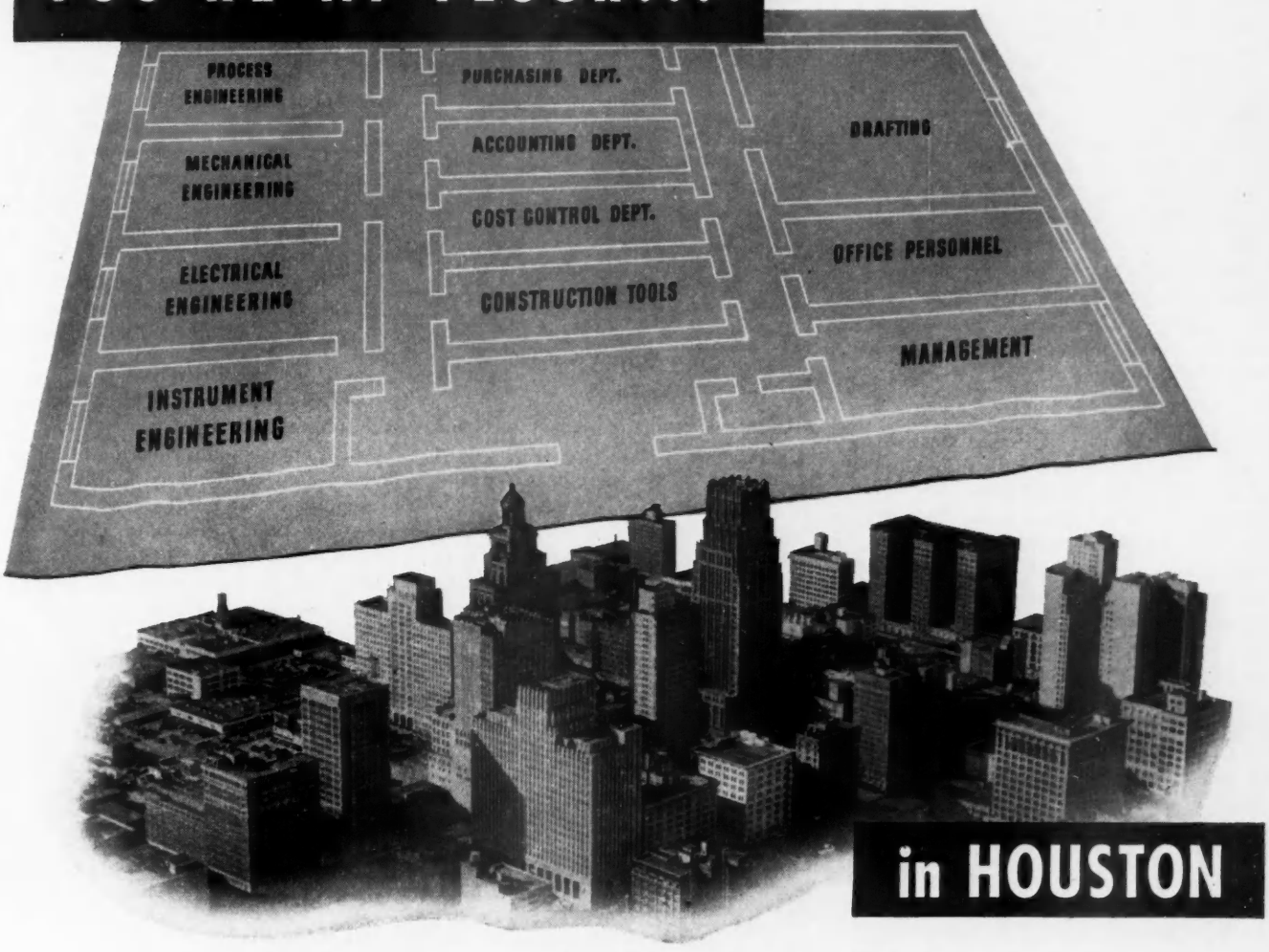

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- Dehydration Plant at Kopperston, West Virginia
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Where:

S = Spacing in feet of valve below the valve above

CP = Test block closing pressure of valve above, psi

DVA = Depth of valve above in feet from surface

FG = Estimated tubing flowing gradient, psi per foot of height

SFG = Static fluid gradient, psi per foot of height

For example: with a surface operating pressure of 700 pounds, static fluid level at or near the surface, a static fluid gradient of 0.40 psi and a flowing gradient of 0.20, a setting for continuous flow valves would be as shown in Table 4.

Useful Work of Injected Gas

The correct application of differential or continuous flow gas lift requires understanding of the basic theory underlying it. R. E. Bobo devised a method for determining the amount of useful work accomplished by the injected gas in a differential or continuous flow installation, this work being independent of that performed by the reservoir energy.

For purpose of illustration, assume that the bottom-hole pressure in a well takes the liquid from a reservoir and raises it vertically in a tube to a specified height above the surface of the reservoir, at which point the static head occurs.

Under these conditions, a given pressure is developed. If this pressure at various depths in a tube were plotted, a graph such as is shown in Figure 17 is obtained. Pressure in the eductor tube will remain at zero until the top of the fluid at the static head level is reached. Then the pressure will increase uniformly until a pressure is reached reflected by the static bottom-hole pressure. The effective head developed by the bottom hole pressure at static level will be equivalent to "B" feet of liquid, this head of liquid being supported by the bottom-hole pressure.

Let us now suppose that gas is injected into the tube at some point below the static fluid level. In order to do this,

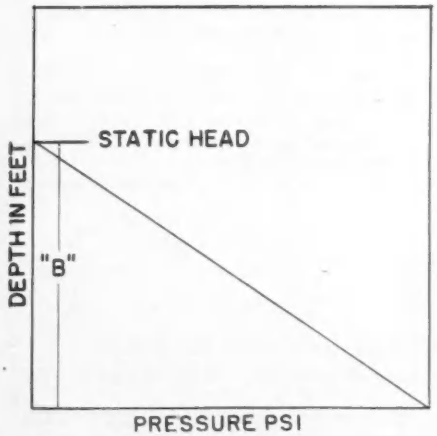


FIGURE 17

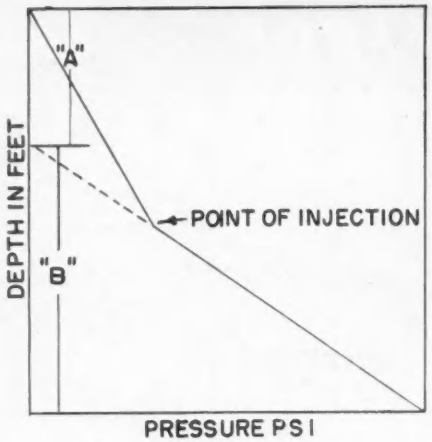


FIGURE 18

the gas pressure at the point of injection must be greater than the hydrostatic pressure which exists within the tube at that point.

As the gas is injected into the tube, the resulting gas-fluid mixture is of much less density than that of the fluid itself. As this gas-fluid mixture becomes lighter, the fluid in the tube rises and the mixture seeks a level wherein the total weight of the liquid and the gas-fluid mixture in the tube will exert a pressure equal to the bottom-hole pressure. If enough gas is introduced into the tube to sufficiently lighten the fluid, the gas-fluid mixture will rise to the top and flow will begin. The bottom-hole pressure still develops a hydrostatic head equal to "B" feet of liquid, and the injected gas, therefore, is effective in lifting the liquid through the remaining distance to the surface.

Plotted graphically (Figure 18), the same pressure gradient from the bottom of the hole to the point of injection may be observed. At the point of injection, however, the gradient becomes less and remains so to the surface. In order to find the lift due to the bottom-hole pressure, merely extend the gradient which exists below the point of injection until it intersects the pressure ordinate. The head due to the bottom hole pressure is "B," that due to the injected gas is "A." This is a fundamental relationship.

Applying this theory to a pressure survey (Figure 19), we find that the gradient of the fluid in the tubing below the lowest valve that admits gas corresponds to that caused by the density of the well liquid and produced gas itself in addition to friction, and, of course, is greater than that above the point where the gas is introduced. By extending this heavier gradient line until it intersects a line drawn vertically and equal to the surface tubing pressure, a point is found that corresponds to a particular well depth.

If it were possible to lower the wellhead connections to this point, and at the same time maintain the same surface tubing pressure, the well would flow at essentially the same rate as it does under lift conditions. Hence, the injected gas lift fluid from this point to the surface represents the actual lift in feet. The injected gas does not, therefore, perform all the work of lift from the point of injection, as is often supposed.

Efficiency

S. F. Shaw[2] offers the following data on lifting efficiencies.

As an approximate rule, the lifting efficiency can be computed as that of the percentage of submergence when operating at a maximum capacity. Under conditions of high submergence, it has been proven that the efficiency percentage is less than that of submergence. Under conditions of low submergence, the efficiency percentage might be many times higher than that of submergence. Within the general range of oil field operations, however, submergence is between 10 and 20 percent and the lifting efficiency can be taken as roughly equivalent to the submergence for results that are sufficiently close until actual tests under the particular conditions encountered prove that the figure should be varied accordingly.

To compute the percentage of submergence, let us assume a working pressure of 300 pounds, a lift of 3000 feet, specific gravity of the fluid produced 0.80. Considering that 1 psi of pressure is equivalent to a column of water 2.304 feet high, the working pressure of 300 pounds is equivalent to a submergence of:

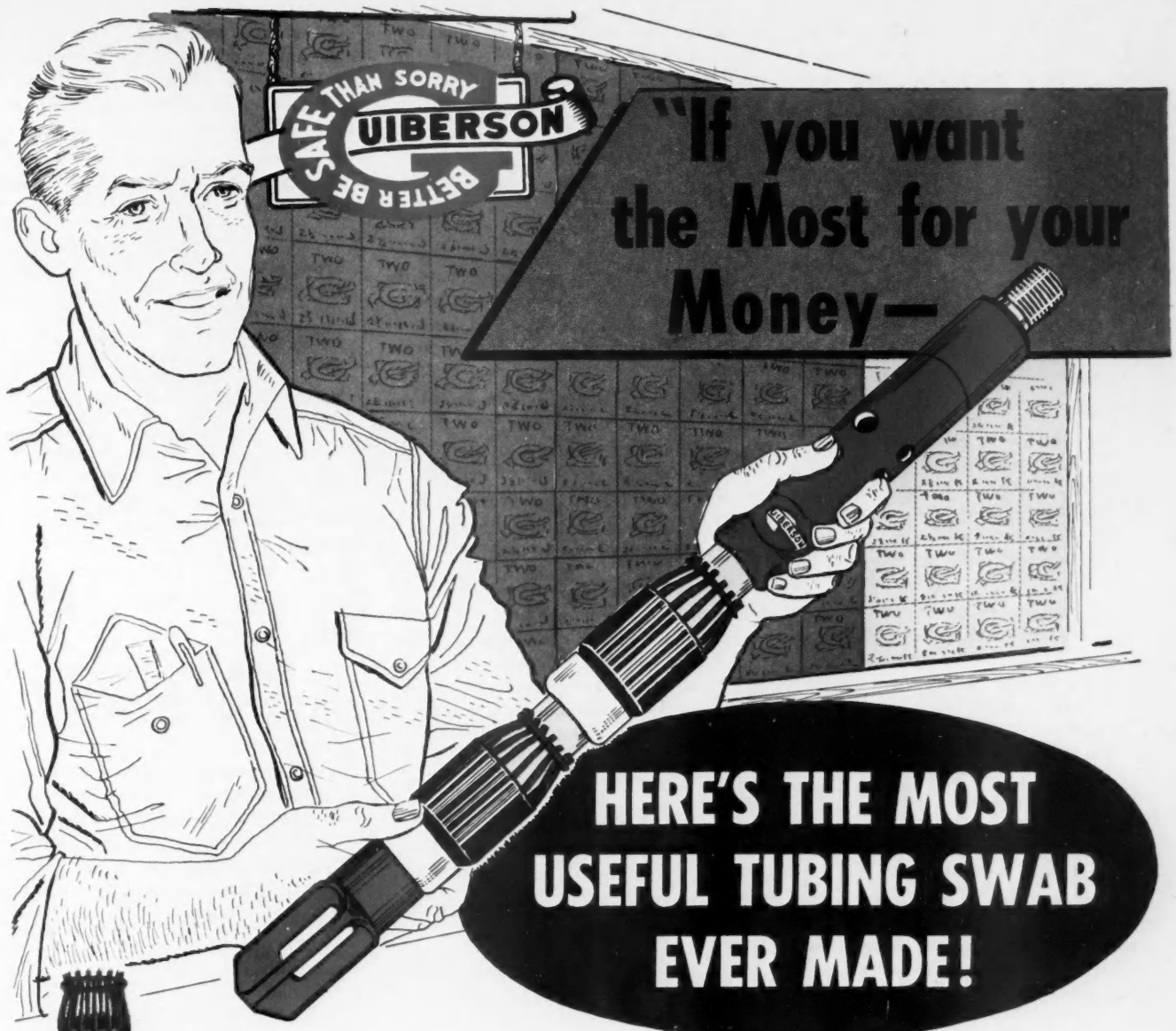
$$\frac{300 \times 2.304}{0.80} \text{ or } 864 \text{ feet}$$

The percentage of submergence then is:

$$\frac{864}{3000 + 864} \text{ or } 22.3$$

The foot-pounds of work required to lift a barrel of fluid a given distance is obtained by multiplying the weight in pounds of the barrel of fluid by the vertical distance it is to be lifted. For instance, a barrel of water weighs approximately 350 pounds. If this barrel of water is to be lifted 2000 feet, the foot-pounds of work required would be 350 × 2000 or 700,000 foot-pounds. If oil

Valve No.	Depth	Spacing	Surface Operating Pressure	Gas Column Weight	Test Block Close	Spacing Calculations
1	1500′	1500′	640#	25#	665#	700#—100# + 0.40
2	2350′	850′	630#	38#	668#	(665#—25#)—(1500 x 0.20)+0.40
3	2782′	432′	620#	44#	664#	(668#—25#)—(2350 x 0.20)+0.40
4	2989′	207′	610#	47#	657#	(664#—25#)—(2782 x 0.20)+0.40



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having a specific gravity of 0.80 is to be lifted, the foot-pounds required would be $350 \times 0.80 \times 2000$ or 560,000 foot-pounds.

By using the tables of foot-pounds required to lift a barrel of water and the table of foot-pounds required to compress one cubic foot of gas isothermally to a given pressure, it is possible to obtain a figure on the number of cubic feet of gas required to lift a barrel of oil a given distance.

This equation would read:

$$(16) \qquad R = \frac{W \times S}{(C - Cb) \times E}$$

Where:

R = Cubic feet of gas required to lift one barrel fluid

W = Foot-pounds of work required to lift one barrel of water a specified vertical distance

S = Specific gravity of fluid to be lifted

C = Foot pounds of work required to compress one cubic foot of gas isothermally to a given pressure working pressure

Cb = Foot pounds work required to compress one cubic foot of gas isothermally to a given pressure —back pressure

E = Efficiency — percentage of submergence

For example: the number of cubic feet of gas required to lift one barrel of fluid from a depth of 3000 feet with a working pressure of 300 pounds, a fluid specific gravity of 0.80, a surface back pressure of 20 pounds and percentage of submergence of 22.3, this equation would read:

$$\frac{(350 \times 3000) \times 0.80}{(6486 - 1810) \times 0.223} =$$

$$\frac{1{,}050{,}000 \times 0.80}{4676 \times 0.223} =$$

$$\frac{840{,}000}{1043} \text{ or } 805 \text{ cubic feet}$$

It has been suggested that for computing the theoretical minimum quantity of gas required per barrel to reduce the static gradient of a column of fluid to a flowing gradient, the following equation may be used:

$$(17) \qquad Q = (5.61)\left(\frac{SG - FG}{FG}\right)\left(\frac{SP + OP + 2BP}{2BP}\right)$$

Where:

Q = Theoretical minimum quantity of gas required per barrel to reduce a column of fluid from a static gradient to a flowing gradient

SG = Static gradient of fluid column, psi per foot of height

FG = Flowing gradient of fluid column, psi per foot of height

SP = Surface separator pressure, psi

OP = Operating annulus pressure, psi

BP = Base pressure of gas

For example: the theoretical minimum quantity of gas required per barrel to reduce a column of fluid with a static gradient of 0.40 to a flowing gradient of 0.15 with an operating annulus pressure of 500 pounds, a surface separator pressure of 30 pounds and a gas base pressure of 14 pounds, would be:

$$Q = (5.61)\left(\frac{0.40 - 0.15}{0.15}\right)\frac{(30 + 500 + 28)}{28}$$

$= (5.61)(1.66)(19.9)$ or 185 cubic feet

Foot-Pounds of Work

A factor to consider in selecting an operating pressure is the foot-pounds of work contained in compressed gas. If gas is compressed isothermally, a certain number of foot-pounds of work is required to raise a unit volume of perfect gas from a given pressure to a higher pressure. The greater number of foot-pounds is required at the lower pressures with the foot-pound requirements decreasing at the higher pressures.

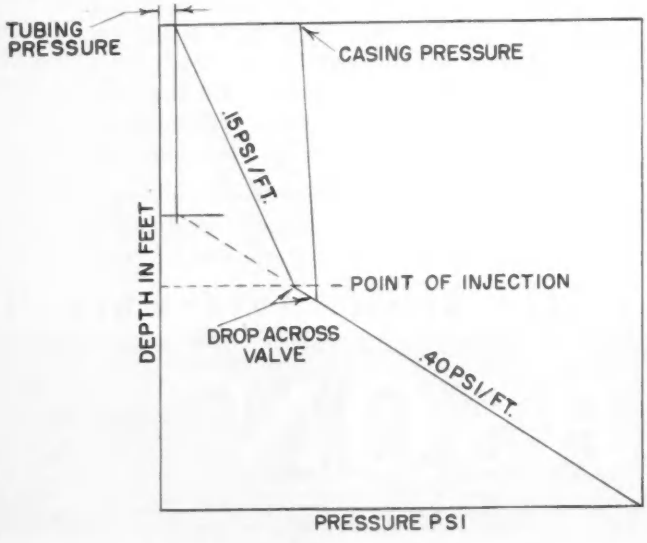

FIGURE 19

If the same perfect gas were allowed to expand from the higher pressures to the lower pressures, the quantity of work performed by the expanding gas, under the same conditions, remains the same.

For example, gas allowed to expand isothermally:

From	To	Foot Pounds Work Performed
700#	600#	320
600#	500#	375
500#	400#	458
400#	300#	583

From	To	Foot Lbs. Work Performed	Average per 100 Lbs. Expansion
700#	100#	3,873	645
600#	100#	3,553	711
500#	100#	3,178	794
400#	100#	2,720	907
300#	100#	2,137	1,068

Casing Flow Operations

Automatic differential and continuous flow valves are especially adaptable to casing flow operations. When it is necessary to lift quantities of fluid beyond the capacity of tubing flow, the valves are mounted inside the tubing string on special mandrels and gas is injected in the tubing and through the valves into the casing annulus to flow production through the casing.

In this operation, the valves are sometimes utilized to lower the working level to a point where it is possible for the injected gas to enter the casing annulus through the bottom of the tubing. Greater efficiency is obtained under these conditions where exceptionally large quantities of fluid must be produced.

It is necessary, in this operation, that flow lines from the well-head have a flow area equal to or greater than the flow area of the casing, otherwise the gas will break through at the well-head and fluid will drop back.

Due to a lack of sufficient detailed information on this type well, it is usually difficult to compute the proper submergence for this flow. Generally the tubing is raised or lowered until the proper submergence is found to meet production requirements.

ACKNOWLEDGMENT

Acknowledgment for valued assistance in compiling data for this article is hereby made to the following: M. L. Livingston, chief engineer, Merla Tool Corporation, Dallas, J. L. Robison and A. I. Robinson, Odex Engineering & Equipment Company, Odessa, Texas; A. C. Mock, Merla Sales & Service Company, Houston; and Houston Parish, Engineering Service Company, Corpus Christi, Texas.

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[1] Bobo, R. E. "Efficient Continuous Gas Lift." *The Oil Weekly*, p. 34, Vol. 125, No. 3, 1947. (March 17.)

[2] Shaw, S. F. "Gas Lift Principles and Practices." Gulf Publishing Company, 1939.

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The Best by Any Test!

Permeability Surveying *and* Controlled Acidizing

By BENSON M. KINGSTON
Chief Petroleum Engineer, The Chemical Process Company, Breckenridge, Texas

SEPARATE PERMEABLE ZONES of the producing formation must be considered individually in order to obtain economically the maximum production from a well. Methods for increasing the permeability of the producing zone such as acidizing, shooting and fracturing must be judiciously applied. This article was prepared for WORLD OIL from a slide talk presented at a meeting of the West Central Oil & Gas Association, Abilene, Texas.

TO ACIDIZE properly a well which produces from two or more zones, it is necessary for the personnel in charge of completing or reconditioning to be able to evaluate definitely the permeabilities of the various strata. This is usually accomplished by inspecting core analyses, drill cutting analyses, electric logs, testing with packers, or by making permeability surveys. This latter method is direct in that the surveys show the relative amounts of fluid that can be injected into the various zones at specific injection rates and definite pressures.

When the permeabilities of the various zones are known and the type of fluid each produces is determined from production tests, formation sample data or electric logs, the supervising personnel with the advice of the acid servicing company can judge which and to what extent each zone needs acidization.

In many fields it is practical to acidize all zones without attempting to treat selectively any separate stratum because of the presence of vertical permeability through fractures and fissures; or because the permeabilities of the various zones are nearly equal and no water or specifically gas producing strata are exposed. In numerous areas where multiple pay zones are present, it is advisable to isolate each zone to be treated. This is accomplished by packers or electrical signaling instruments. Packers are most successful where casing is set through the producing formation. Some types of packers have been satisfactorily used in open hole completions.

Shell Development Company and The Chemical Process Company have recently developed instruments, tools and methods[1] for locating and following the position of an interface between an electrolyte and oil in a well bore. A knowledge of the interface location permits acid injection to be controlled selectively or permeability surveys to be made.

With slight variations the same instruments are used for permeability surveying and acid control work. The signal transmitting instrument consists of a steel pressure-tight tubular case 1⅝-inch in diameter and six feet long which contains dry cell batteries and a type of induction coil. From the lower end of the tube protrudes a brass electrode, one-eighth inch in diameter and six inches long, which is fixed in and insulated from a steel guard attached to the case. The upper end of the case is connected to a reverse armored steel cable containing a single electrical conductor. The electrode is in contact with the batteries and in the induction coil is connected to the conductor in the cable. When the electrode is immersed in an electrolyte, a circuit is completed between the batteries and the coil, generating a series of electrical impulses that are carried through the cable to the receiving instruments.

The instrument is lowered into and raised from wells by means of a cable through a stuffing-box and lubricator attached to the casing or tubing. Depths of the instrument are indicated and recorded by a cable measuring device.

The electrical impulses generated by the transmitting instrument are picked up from the cable through a capacitator and amplified by electronic apparatus. The presence of a signal, or these electrical impulses, is indicated by an eye tube, an ammeter and an audio signal through a loud speaker. When permeability surveys are made, the presence of a signal is automatically recorded on a chart vs. time and depth.

The general principle for accomplishing a permeability survey with the above described instruments is the same as has been used for years in locating casing leaks by pumping a plug down the hole. In finding a casing leak by this method a tight fitting plug is placed in the casing and forced down the hole by pumping fluid on top of it. When the plug passes the leak it stops moving because

[1] The use of the instruments, tools and methods described in this article is protected by U. S. Patent No. 2,473,713. The Chemical Process Company, Division of The Independent-Eastern Torpedo Company, is the sole licensee and incorporates the use of the same in its "Permeter" services.

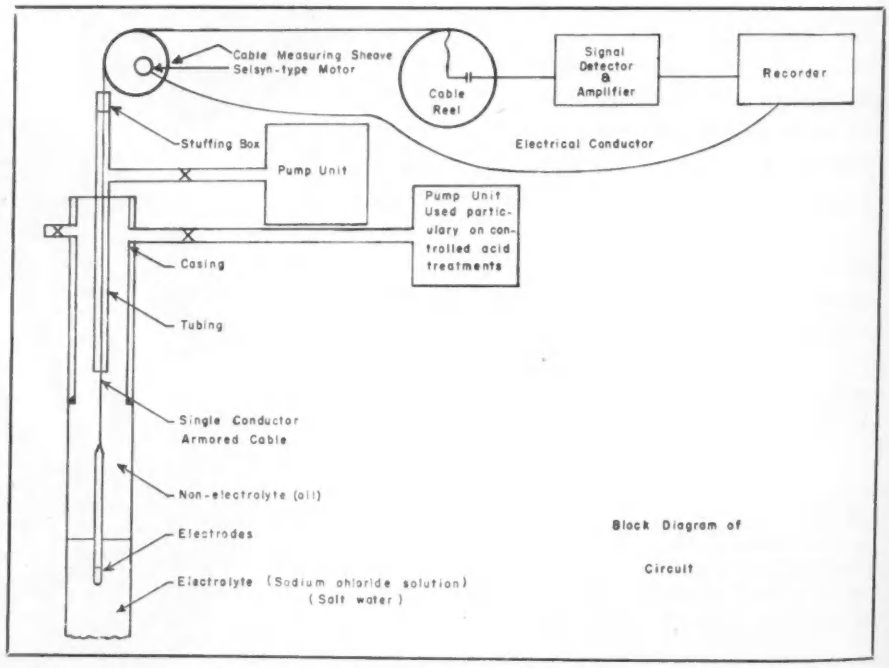
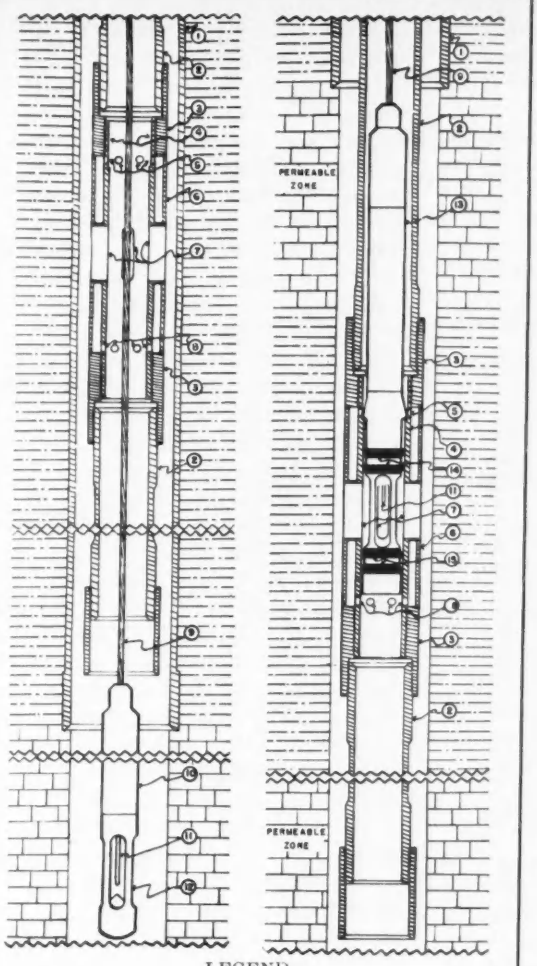


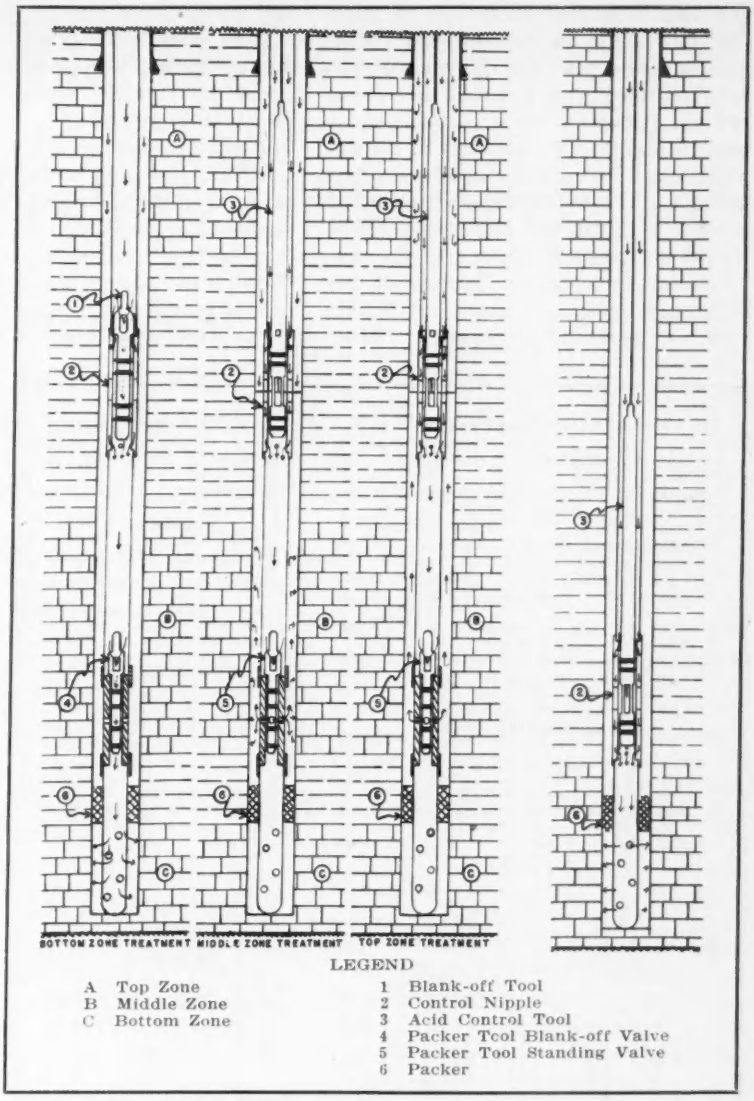
FIGURE 1. The sketch depicts generally how the signal generated by the transmitting instrument in a well is conducted through the cable to the receiving instruments and how the depth of the transmitting instrument is indicated or recorded. The sketch also shows the relative hookup of fluid pumps during a permeability survey and a controlled acidizing operation.



LEGEND

1 Casing
2 Tubing
3 Adapter Coupling
4 Standard 1-25/32" or 2" Seating Nipple.
5 Top Nipple Perforations
6 Sheath
7 Slots (inside of nipple to annulus)
8 Lower Nipple Perforations
9 Steel Cable with Single Electrical Conductor Core
10 Permeter Signal Transmitting Tool with Survey Bottom
11 Electrode
12 Survey Tool Bottom
13 Permeter Signal Transmitting Tool with Acid Control Bottom
14 Upper Cups on Acid Control Tool Bottom
15 Lower Cups on Acid Control Tool Bottom

FIGURE 2. Drawing on left shows diagrammatically how a permeability survey is made with tubing and an acid-control nipple in the hole. Drawing on right depicts acid-control nipple located in the tubing between two permeable zones, either of which can be acidized.



LEGEND

A Top Zone
B Middle Zone
C Bottom Zone

1 Blank-off Tool
2 Control Nipple
3 Acid Control Tool
4 Packer Tool Blank-off Valve
5 Packer Tool Standing Valve
6 Packer

FIGURE 3. Three-zone treatment with packer.

the pumped fluid is passing out of the casing through the leak and is no longer exerting any propelling force.

In making a survey, an electrolyte (a sodium or calcium chloride solution containing demulsifying and surface tension lowering agents) is used instead of a plug. This material is placed in the bottom of the hole covering the sections to be surveyed. Oil is pumped on top of the electrolyte to force it down. The transmitting instrument indicates the top of the salt solution and follows it downward. Since a constant oil pumping rate is maintained, a decrease in the rate of fall of the electrolyte indicates permeability in the formation immediately above the point where the rate slowed down. When the solution stops moving, all permeable zones have been passed.

Figure 1 illustrates the method used for lowering the transmitting tool and recording the rate of fall of the electrolyte.

Controlled acid treatments are accomplished with the instruments by inserting a special seating nipple into the tubing string either slightly above or below the zone to be treated.

This control nipple is constructed of a standard seating nipple with adapter couplings on each end. Perforations are made in the nipple near the ends. A tubular sheath, the inside diameter of which is slightly smaller than the outside diameter of the couplings, is placed over the nipple and welded to the couplings. Near the middle of the device, slots are cut through the nipple and sheath, and the aperture between is closed by welding.

The electrode guard on the transmitting tool is replaced with a slotted device holding seating cups in such a manner that when the transmitting tool is lowered into the nipple, the electrode is packed-off from the tubing below and above. The cup-holding device seats in the top of the nipple in such a manner that the electrode is opposite the slots.

With this arrangement the transmitting instrument will generate a signal only when acid, or other electrolyte, is on the outside of the tubing and opposite the slots in the seating nipple.

When the zone below the nipple is to be acidized, the hole is filled with oil and acid is spotted over the section to be treated with the acid-oil interface opposite the electrode. Oil is then pumped down the annular space between the tubing and the casing while acid is being injected into the tubing. Pumping rates are adjusted so that a signal will result if the casing pump is slowed or the tubing pump is speeded.

When the zone above the nipple is to be treated, the casing is filled with oil

and acid is spotted above and through the slots in the nipple before the transmitting tool is seated. After the tool has been set, oil is pumped into the tubing and the casing (if the size of the treatment is less than the capacity of the annular space between the casing and the tubing). The pumping rates are adjusted so that a signal will be transmitted if the tubing pump be slowed or the casing pump be speeded. Because of the differences in specific gravity, it is necessary to perform the operation of spotting the acid and starting the treatment with as much speed as possible in order that a true interface may be maintained. These methods of treatment are illustrated in Figure 2.

Where other zones in a well take fluid considerably more easily than the one to be treated, it is advisable to use a viscous filler such as oil-base mud rather than oil for holding the acid in place during treatment. A much higher pressure is required to force such a viscous material into the rock than would be required with oil. Thus it is possible to maintain sufficient pressure to force acid into the least permeable section.

It is possible to save a trip with the tubing if a permeability survey and controlled acid treatment are to be used consecutively. This is accomplished by running the tubing with the nipple inserted near the bottom of the string and leaving the bottom of the tubing elevated in the casing. After the survey has been made the nipple may be lowered to the desired position in the hole.

By use of the seating nipple in conjunction with a packer it is possible to treat positively three separate zones without moving the tubing. A packer with a choke-type acidizing tool immediately above the rubber is set on top of the bottom zone. The acid-control nipple is inserted in the tubing string between the top and middle zones. Blankoff valves are run in the acidizing tool and the seating nipple which shuts off perforations and slots respectively, and permit the fluid to be pumped through these devices confining it to the tubing. The lowest zone is then given a conventional packer type treatment.

The blankoff valves are removed and a check valve (standing valve) is then run in the acidizing tool which permits fluid to be circulated from the tubing to the annulus or vice versa but prevents the pumping of fluid through the packer to the lowest zone. The upper two zones are then acidized with controlled treatments in the manner already described. Figure 3 depicts these operations.

A packer seat may be tested by use of the acid-control tools. To accomplish this operation a control nipple is inserted in the tubing string directly above the packer. The transmitting instrument with cups attached is set in the nipple and an electrolyte is pumped down the tubing. If the packer seat leaks, the electrolyte will come around the packer and cause the transmitting instrument to give a signal. Figure 3 illustrates this method of packer testing.

It is possible to use the control nipple to seat standard insert type well pumps by the use of a special hold-down tool which uses 1 15/16-inch seating cups. A well may be pumped through the slots in the seating nipple or from the bottom of the tubing by attaching 1 25/32-inch seating cups to the hold-down tool so that the slots are packed off.

Like all other tools and instruments, these tools have limitations. These survey and control tools are best adapted to wells which are capable of being completely filled with fluid and are impractical for use in wells which have extremely low fluid levels and highly permeable producing formations.

"PERMETER" INJECTIVITY LOG
Date: 9-15-48.
Company: Horizon Oil Company.
Fee: Speil Well No. 4
Location: Sec. 28, Twp 21, Rng. 15 w
Field: Pine Island.
County: Caddo. State: Louisiana
Formation surveyed: Chalk
Casing size: 5½ in. Wt. 14 Lbs.
Set at 1441 Ft.
Tubing size: 2 in. Wt. 5 Lbs.
Set at 1250 Ft.
Hole size: 7⅞ in. Total depth 1523 Ft.
Zero point casing head
Electrolyte: 1000 gals. Oil: 75 Bbls.
Casing pressure: 350 psi.
Tubing pressure: 250 psi.
Pumping rate: 25.6 gal./min.
PERMEABLE ZONES
1480 ft. to 1482 ft. 30% of total permeability
1489 ft. to 1491 ft. 26.7% of total permeability
1498 ft. to 1500 ft. 16% of total permeability
1507 ft. to 1513 ft. 27.3% of total permeability

"PERMETER" INJECTIVITY LOG
Date: 3-5-48.
Company: Goode Oil Company
Fee: Scharbaur "G." Well No. 2
Location: 330'fr SL of Sec 33, Blk 44, T-1-N, T & P Sur
Field: Goldsmith
County: Ector State: Texas
Formation surveyed: San Andres
Casing size: 7 in. Wt. 24 Lbs.
Set at 4173 Ft.
Tubing size: 2½ in. Set at 3900 ft.
Hole size: 6¼ in. Total Depth: 4235 ft.
Zero point: 10' above collar.
Electrolyte: 250 gals. Oil: 39 bbls.
Casing pressure: 300 psi.
Pumping rate: 30.4 gal./min.
PERMEABLE ZONES
4182 ft. to 4184 ft. 39.4% of total permeability
4214 ft. to 4216 ft. 15.5% of total permeability
4222 ft. to 4225 ft. 14.8% of total permeability
4233 ft. to 4235 ft. 30.2% of total permeability

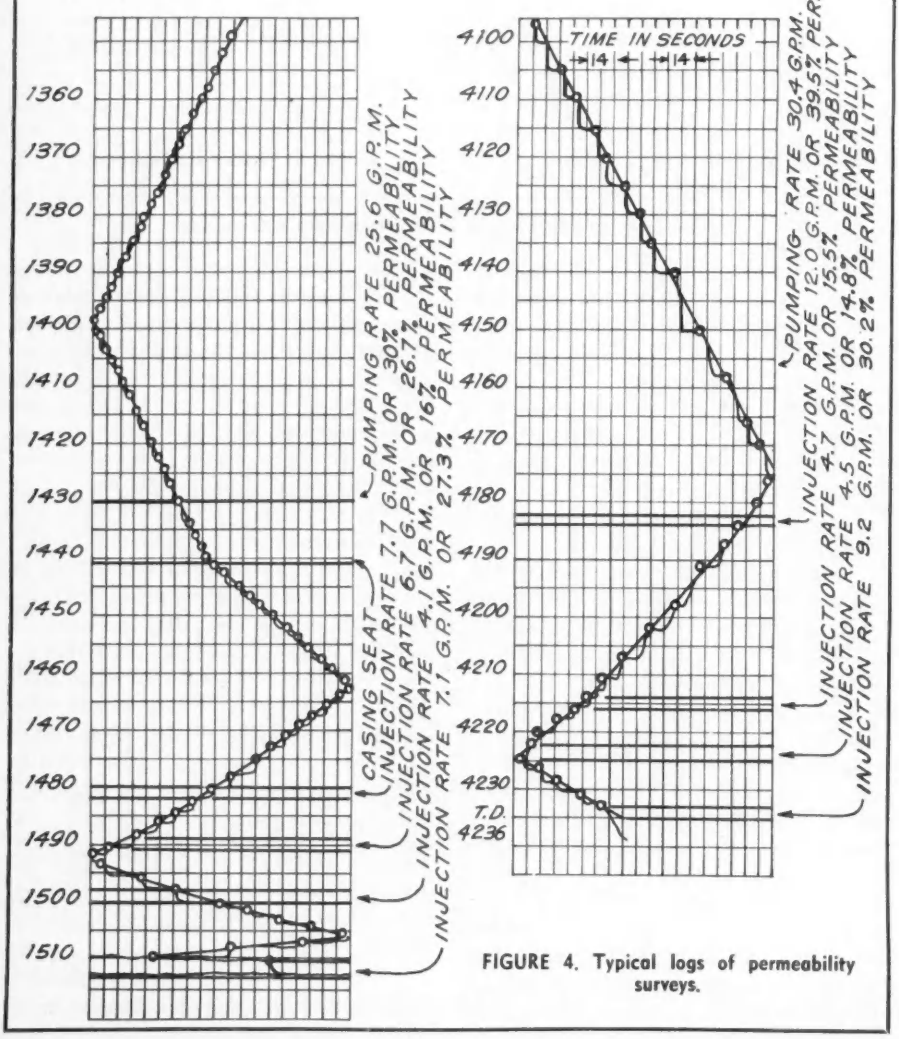


FIGURE 4. Typical logs of permeability surveys.

Effect of *Well-Plugging Techniques*

By F. R. COZZENS

Field Foreman, Equity Oil and Gas Company

THE AUTHOR outlines proven methods for plugging wells during the process of abandonment, specifying sequences of operations which will protect each sand and at the same time insure continuity of the plug so as to insure the property against water intrusion in case of later water-flood or other secondary recovery practices.

PRACTICALLY all petroliferous formations contain unstable water, and any mechanical effort which reduces static head-pressure at a given point likewise entices migratory water to that particular zone. Due to this fact, an area of sand being partially depleted of oil is far more susceptible to water damage than are virgin strata of the same type. Migrant saturation is most likely to occur from edge-water, surface drainage, or planned floods, where the main water bank disintegrates and portions of it become mobile in the sand.

Another common cause is an underflood which originates in the base of a sand, or in the bedding planes immediately below it, and rises under pressure into areas being depleted of natural energy. The rise is accomplished through horizontal flow-channels which predominate in sand layer fusions, refractive permeabilities, clay deposits, and in certain shales. Once within an area of low resistance, water from any origin may migrate in favorable directions until reaching space sufficient to permit the flood to become static. Points most receptive to water-heads are structural dips, cavities and fissures, and particularly shot fracture patterns unintentionally left open when plugging abandoned wells. Unsealed fracture patterns which have been depleted of oil by continuous stripping over a course of years, are especially attractive to migrating water because of (1) extremely low resistance; (2) unstable oil-water ratios or fluid balance; (3) vacuum action, established in the capillaries during partial depletion.

To prevent these spots, which generally have a fracture radius of 20 to 40 or more feet, from becoming flooded a wide variety of plugging laws, rules, and regulations have been formulated. Much diversified as to verbiage, according to states and districts, one uniform basic requirement is that a stable and impervious plug be placed in the top of each productive sand or producing horizon while the annulus is in process of being filled. Properly located and seated, the plugs seal off all water above a specified formation, but are not intended to seal off water from within a sand-column, or from below it. Inner sand protection must be provided by the filler. Type of filling material used and manner of its application are theoretically determined by the prevalence of water within the area in which the well is located. Water distinction between districts is generally based upon well records and field observations usually made without the aid of sand-coring or core analysis. This manner of classification is unreliable in a practical sense, because reservoir fluid movement is extremely complicated, and many flow trends and capillary functions are not clearly understood. A sand's susceptibility to water encroachment is therefore, unpredictable, and cannot be determined with any great accuracy from derrick-floor samples, or from records of initial producers. This fact is being proven continuously in reconditioning stripper fields for secondary oil recovery measures. In redrilling supposedly "watered areas," many unplugged abandonments are found to have remained dry over periods of 25 to 50 years, while in areas classified as "safe," anywhere from 5 to 20 percent of the plugged wells show definite evidence of flooding.

Plugging regulations in so-called "safe" areas, which comprise the majority, are comparatively lenient. Shothole filling material is usually common clay, dug up at the site. Before the first plug is dropped, a procedure which often escapes censure is to dump, or shovel the filler into the well, many of the chunks or segments being reduced only to a size which will reach bottom safely without bridging the annulus. The mass does not pack in the shot hole, and little or none of it reaches the fracture-fissures. Instead of repelling water, a filler applied in this manner actually becomes a model water-conductor. When, and if, the porous mass becomes thoroughly saturated, a further linear fluid-rise is blocked by the plug in the sand top, thus causing a pressure-head to develop. Gradually, the excess of accumulating water is pressured out in various directions through the fracture-fissures. Thus is born a flood which soon becomes sufficiently potent to entrap oil, cause Jamin actions and by-passing, increase oil-water ratios, and to interfere in divers other ways with the function of a repressuring agent. All such behaviors are expensive, yet fortunately they are proving instrumental in arousing general interest in more progressive methods of sealing abandonments. It is now being conceded by both oil producers and plugging inspectors that existing methods of cataloging sands are impractical, and that inasmuch as subterranean fluid migration is treacherous, no area or district can be authoritatively pronounced safe.

The fundamental corrective need, however, is not for new, or more stringent plugging laws, but for a better mutual understanding of the problems involved. More laboratory research and experimental work is necessary to promote the discovery and development of better plugging materials, and admittedly, much more field effort and ingenuity should be utilized in applying materials we already possess. In this latter respect, many eastern oil producers are taking the initative by having prospective abandonments mechanically ready for plugging before the inspector is called out. Initial attention is given the fact that any well which can no longer be operated to advantage or for any practical purpose, should be abandoned and

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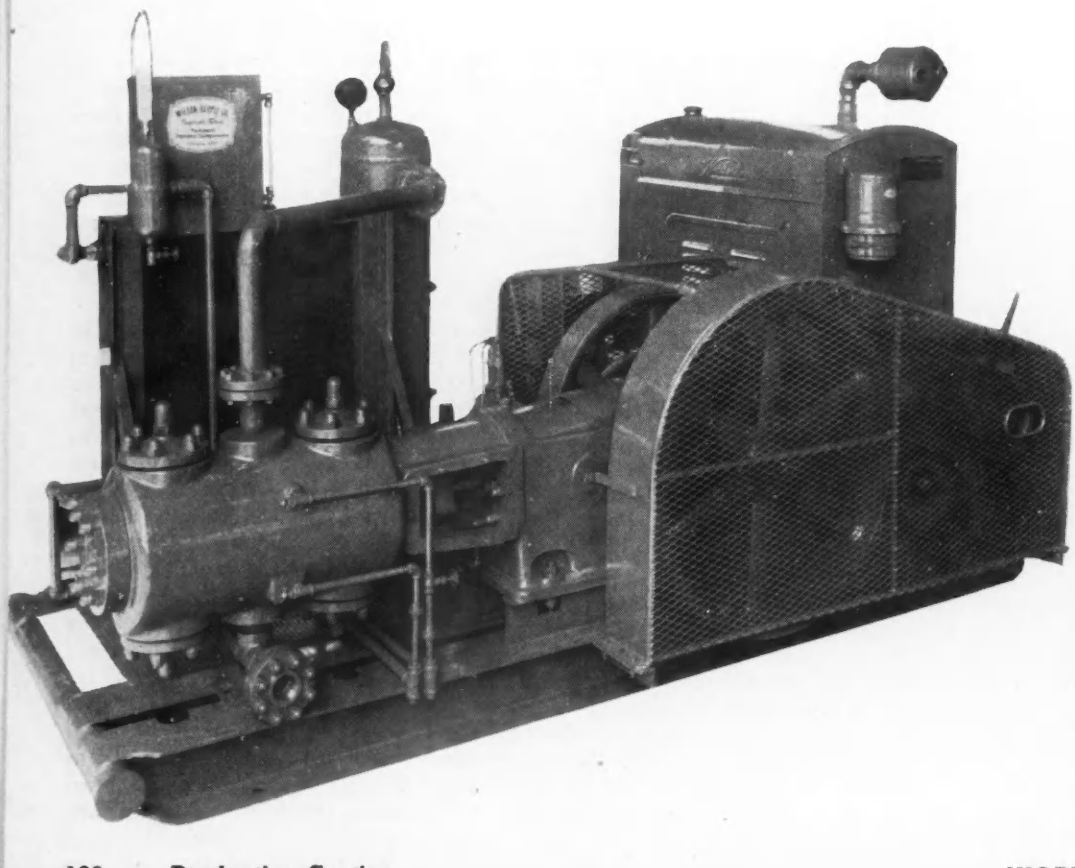

4 1/8" x 9"—ES-1
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LOUISIANA

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plugged immediately; not hung off the pump, and allowed to remain open for months or years.

Promptly upon abandonment, the shot hole or bore cavity of each well selected is pumped, swabbed, or bailed as dry as possible. Tubing and rods are removed, and any packers, liners, or other obstacles which might interfere with the free running of a plugging agent are fished out or destroyed with dynamite. Any pocket or bore extension below the sand-base is sealed off with a bridge, backed up by 3 to 5 linear feet of cement slurry. Steel line measurements are then taken from sand-base to casing shoulder so as to provide working knowledge of shot hole capacity. Such dimensions are often computed by multiplying the length of the sand column in linear feet, by 3 feet, which, roughly estimated, is the diameter of the average sand-bore (at points) after shooting. These computations, along with other specific measurements, such as well depth, distance between sands, etc., are submitted to the plugging inspector for that area; and through discussion the type of filler material and methods for its application are determined. Equipment for introducing the medium is usually assembled on the job. Necessary requirements are plenty of water; hose or line to water supply; mortar hoes; and an inclined trough, or mixing vat, with spout of length sufficient to reach the annulus. Certain operators have available for well-plugging purposes a string of 3-inch diameter line pipe through which the filler is introduced into the shot hole so as to eliminate the cleaning and swabbing of the casing afterwards. Running and pulling the pipe, however, add considerably to the cost of a plugging job, and the practice, except in rare cases, is seldom advised.

Among the various plugging fillers, certain clays, principally fire clay and clay-stone (argillite), remain the favorites in eastern areas. Fire, or brick clay, either red or yellow, can be obtained through commercial sources in the required powdered form and clay-stone may be processed locally by the use of an ordinary mill or pulverizer, with screens adjusted for sufficient fineness. Drill-cuttings of subsurface clays or gluey formations with a low content of granular sediment provide excellent filler material. Many operators, when redrilling and reconditioning stripper fields often save and store such cuttings in a separate sluice pit for later use when plugging abandonments. Powdered limestone, to which Portland cement is added in proportions of 1 part cement to 20 parts lime, is a satisfactory filler which not only packs firmly in the shot hole, but also provides a glazing or sealing effect upon capillary openings in the sand-face. Similar sealing effects can likewise be obtained with a combination of lime, plaster-putty, (non-fibrous), and gel-type cement. All clays, lime, cement, etc., are thoroughly saturated with water in the trough or mixing vat, and stirred until smooth and plastic, then gradually introduced into the well. If annulus pipe is wetted before filler is started, less adherence or clogging of interior will result. After the filler registers (by measurements) at the top of the sand column, there should be a waiting period of 1 to 3 hours, or until the mass firms and settles into position. Heavily shot wells, logically, have more and larger fracture cavities than do unshot wells. Therefore more time is required for the filler to confirm to the contour of the reservoir.

During and after the waiting period, more filler is introduced until the apex becomes stable at the sand top. The first plug is then dropped, and after its position has been determined, the casing is lifted 30 to 60 feet (depending upon length of sections). Assuming the plug to be tight, and properly seated, annulus filling is begun, and some leniency can be granted in annulus plugging through non-producing formations. Common clay is the type of filler most widely used, and may be pulverized into granular form and applied dry. If, however, a stray or undeveloped oil sand is known to be present within the upper stretches of bore, measurements are taken, and the former shot-hole filling procedure is again carried out. An oil-bearing formation, regardless of type, depth, or location, is a treacherous spot, and fully 95 percent of all plugging effort should be directed upon it.

Powdered Fillers

On various occasions, powdered fillers have given effective results when introduced in dry form to a shot hole or sand cavity. Less time and labor are required by such introduction, and the users believe that fluid seepage into the shot hole will saturate the filler and thus cause it to settle properly. However, the practice has several objectionable features, the principal one being that dry filler is fluffy, and assembles in the form of a cone or pyramid within the shot hole, so that correct quantities cannot be determined. The apex may reach the sand-top before the reservoir is more than 2/3 filled. This condition can be remedied to some extent by mechanical means which tend to keep the apex levelled off. The agent most commonly used is low-strength dynamite, a cartridge being dropped down the annulus and exploded in the shot hole at intervals as the reservoir is filled. Another objection to the use of dry material is that subsurface saturation of the mass is not uniform, and excess water may channel through it. It also follows that oil forms some percentage of the seepage, and this causes interference with water-saturation at various points. Logical evidence would thus indicate that filling materials applied dry, will not seal reservoirs effectively except under favorable conditions.

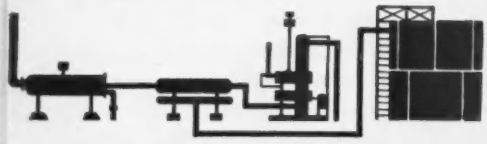
In the reconditioning of stripper fields preparatory to instituting secondary oil recovery measures, ample evidence is being found to support the fact that pumping and operating practices used during primary depletion exert considerable influence upon water movements through that area after part of its wells are abandoned. Continuous stripping of wells where sand-base water prevails tends to encourage a water-rise into horizons being depleted of oil, and a water level which continues to rise despite continuous pumping indicates that a flood is already forming in parts of the fractured pattern, and it is generally more economical to abandon and plug the well, and retrieve its production from a more favorable location.

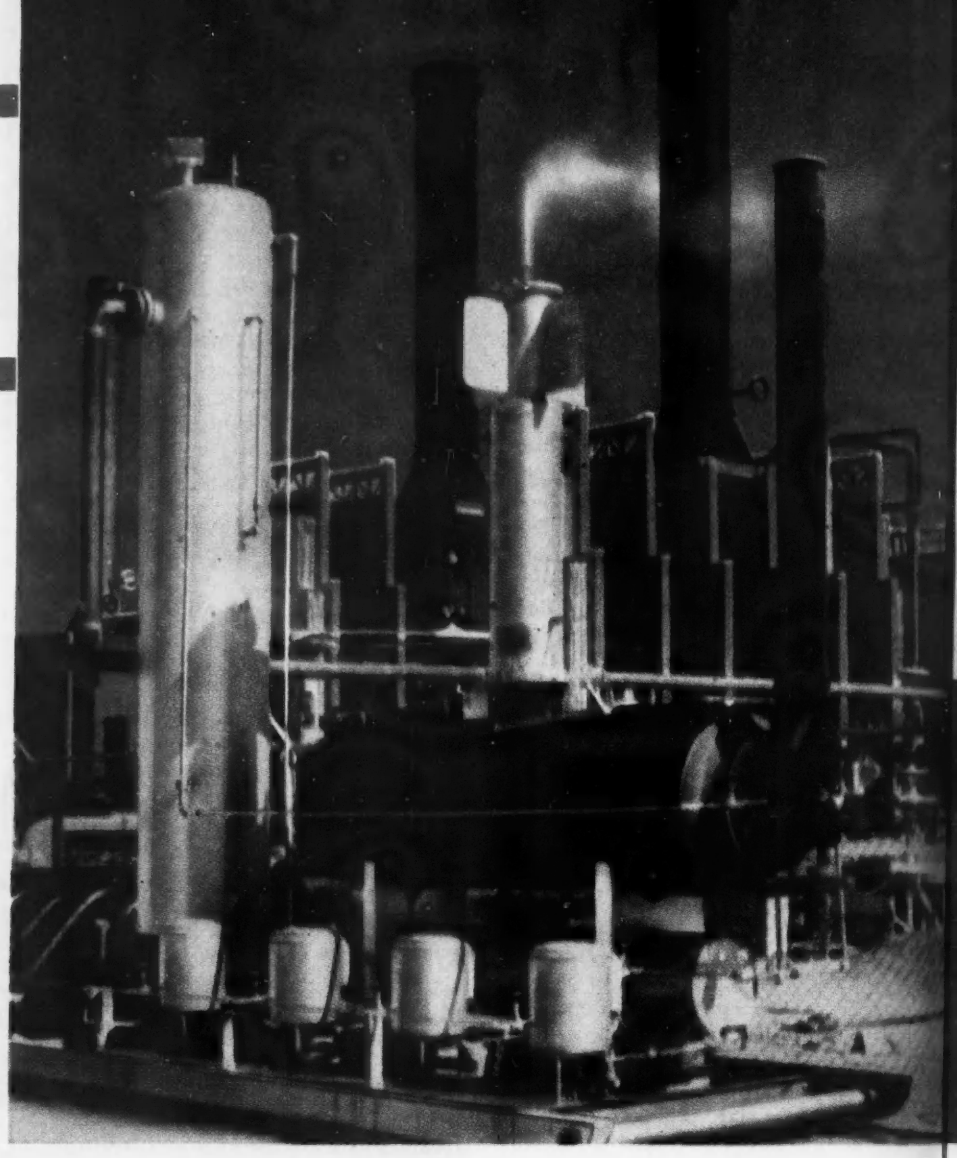
Another adverse practice is to permit wells, because of breakdowns, pulling delays, etc., to remain dormant for long periods. Shot-hole flooding is also created unintentionally through leaks in or around casing, packers, or tubing. Raising of working barrels from time to time as residue accumulates in the base of the shot-hole, is likewise a practice which induces flooding. Shot holes partially filled with semi-solid residue seldom respond favorably to plugging, and where carbide, lye, and other caustic preparations have been used in reconditioning, the resultant sludge or residue (unless removed) is especially detrimental. Such sludge is capable of reactions in the presence of clays or lime, creating gases which increase the porosity of the plugging materials. Facts concerning adverse conditions within a shot hole should never be withheld from a well inspector in order to gain leniency in plugging because invariably the oil producer becomes the ultimate loser.

The crucial test as to the durability of a plugging job occurs when a repressuring agent is applied to the sand. During the first few weeks or months energy supplied from compressors create pressure pulsations which were not present under former reservoir energies. Energy pulsations are readily absorbed through fracture channels extending out from the plugged abandonment, and a premature pressure-head builds up against the filler-packed shot hole. It rarely happens that the plug in the sand-top is disturbed, but the filler underneath it often weakens so that fluid is pressured into the cavity. Such action generally

■ CONTINUED ON PAGE 179

BUDGET BUNDLE #5





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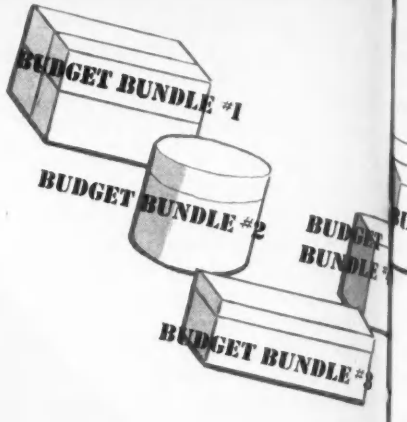

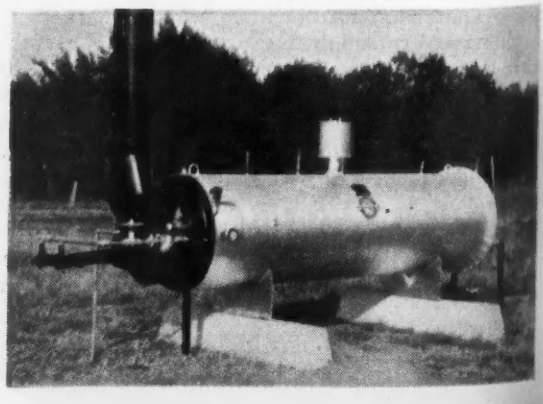

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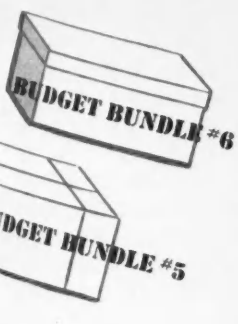

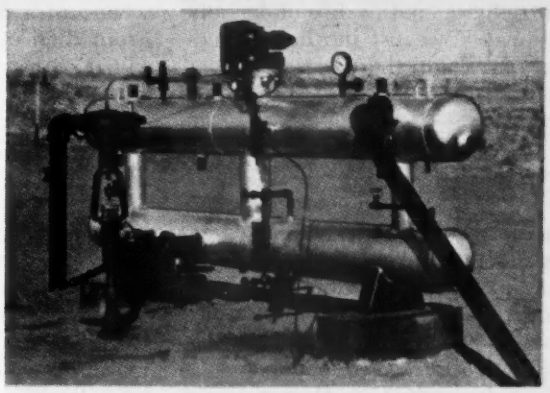

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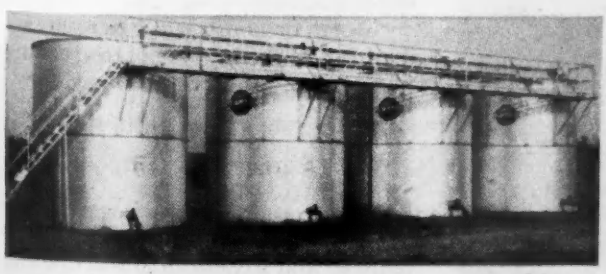

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Surface Preparation for Anticorrosive Coatings

By C. G. MUNGER
Technical Director, Amercoat Corporation

COATINGS which are highly corrosion resistant are becoming an essential part of effective production operations. Each new field can bring in corrosion problems never previously encountered. Cost of steel equipment is steadily increasing, and as equipment becomes more valuable protection by adequate coatings becomes an increasing necessity.

Two types of coatings have come into use in protecting equipment, during and since World War II. The first is the vinyl type. Properties which make vinyls especially effective for petroleum production use are its excellent chemical resistance to all mineral acids, dilute concentrations of the lower organic acids, alkalies, both acid and alkali salts, aliphatic petroleum hydrocarbons, and water—both fresh and salt. In addition, they are tough, abrasion-resistant, and flexible.

The second material with outstanding properties in control of corrosion is the heat-reactive thermosetting phenolic coatings. These have the property of being highly resistant to acids and acid salts, and to both salt and fresh water, even at the elevated temperatures often found at the bottom of the string of tubing. These coatings have excellent resistance to petroleum, are very hard, and abrasion-resistant.

With these coatings, many serious production corrosion problems, can be effectively and economically overcome. Application of these materials and prior preparation of the surface have too often caused the early failure of what otherwise would have been an effective coating. The application of these highly resistant coatings has too often followed the old conventional paint techniques. To be effective, these modern coatings require modern treatment, and a whole new concept of surface preparation must be formed when it is realized that such coatings as the vinyls or phenolics are essentially a very thin, inert barrier between two reactive materials.

A. J. Liebman, in his paper, "Surface Preparation and Paint Application Economics," states, "One intends to insulate a product when a paint or coating system is applied. This insulation intends to exclude detrimental products from the metal surface, yet it will also hold under the film any detrimental products not removed before the new paint was applied."

It is believed the great majority of all coating failures are caused by poor surface preparation. Surface contamination reduces coating life under any conditions; however, in the production of petroleum there are a number of factors which increase the need for proper surface preparation if the full value is to be obtained from any coating.

Salt Water Factor

One of these factors, salt water, comes either from marine operations such as encountered on offshore drilling rigs, submerged storage tanks, equipment barges, or the salt water that is present in connection with much crude production. Here it would contact casing, tubing, sucker rods, stock tanks, wash tanks, salt water disposal piping, etc. Bare metal surfaces exposed to salt solutions provide ideal conditions for severe corrosion. If the equipment has been used previously in this service, the possibility of coating failure is doubled. This is demonstrated in Figure 1. The diagram shows that if proper surface preparation is not attained, small amounts of water-soluble hygroscopic salts may be left on the surface of the metal to be coated. Since all organic coatings can be considered as semi-permeable membranes, moisture vapor can pass through the film, and be absorbed by the water-soluble salts on the surface of the metal, creating a concentrated solution at that point. From then on the process of osmosis will take over and pass water through the coating, creating blisters and eventually disruption of the coating.

MANY FAILURES of protective coatings are traceable to incomplete or improper cleaning of the surface before application of the vinyl or phenolic material. The author demonstrates the effect of various surface impurities, and evaluates common methods in vogue for preparing surfaces for corrosion protection.

The second factor which has a definite influence on ultimate coating life is sulfide reaction with iron and steel. (See Figure 2.) This takes place wherever reactive sulfides such as hydrogen sulfide are found. This condition is found especially in the Mid-Continent area from Texas to Wyoming; however, the same situation exists to a lesser degree in California and other oil producing centers. Most affected by hydrogen sulfide are casing, tubing, sucker rods, stock tanks, and water disposal piping. The reaction is one worth demonstrating. In each case there is a limited supply of oxygen and the reaction would be as follows:

$$Fe + H_2S \rightarrow FeS + H_2$$

$$FeS + 2H_2O \rightarrow Fe(OH)_2 + H_2S$$

It will be noted that hydrogen sulfide is regenerated under proper conditions, so that a continuing reaction can take place under an organic film.

provided the surface is not properly cleaned. This particular reaction has been demonstrated many times where early coating failure has occurred when an old tank has been cleaned, the coating applied, and the tank put back in service. New tanks coated at the same time and under the same conditions showed no failure in the same length of time. It has been observed many times when a stock tank is repaired with a new plate and the entire interior blasted, that the old plates in the tank turn a dark color quickly, even though blasted to gray metal, while the new plates remain an even, light gray for a much longer period of time. In this case it is the sulfides which remain in the surface pores of the metal, oxidizing rapidly on exposure to air. The reaction of iron sulfide and oxygen is a rapid exothermic one, often creating enough heat for spontaneous combustion. If a coating be applied over a steel surface containing sulfides it can be readily seen that any passage of moisture vapor through the film will tend to react with the iron sulfide, creating rust underneath the film and evolution of hydrogen sulfide that can continue to react with metal, thus forming a continuing set of corrosive conditions.

Another gas which often causes serious corrosion is carbon dioxide. It reacts first with water to form a weak acid and then with the iron to give iron carbonate. With moisture this readily decomposes to ferrous hydroxide and regenerates the carbonic acid.

$$CO_2 + H_2O \rightarrow H_2CO_3$$

$$H_2CO_3 + Fe \rightarrow FeCo_3 + H_2$$

$$FeCO_3 + 2H_2O \rightarrow Fe(OH)_2 + H_2CO_3 \rightarrow H_2O + CO_2$$

The serious problem here is the highly penetrating quality of CO_2. Many organic films are permeable to it so that any area of poor surface preparation could act as a focal point for accumulation of moisture and CO_2—this causing blistering, under-film corrosion, and coating rupture.

A fourth factor in surface preparation is one of precipitated paraffin on the surface of metals. This occurs to the greatest extent in well tubing and stock tanks. Although it might seem that the crude oil itself would be far more penetrating than the paraffin and thus cause more difficulty, this is not necessarily the case. The paraffin is precipitated on metal surfaces and forms a very tight bond. It has been the writer's observation that even though a tank be well scraped, areas of paraffin are particularly difficult to remove and difficult to see on the

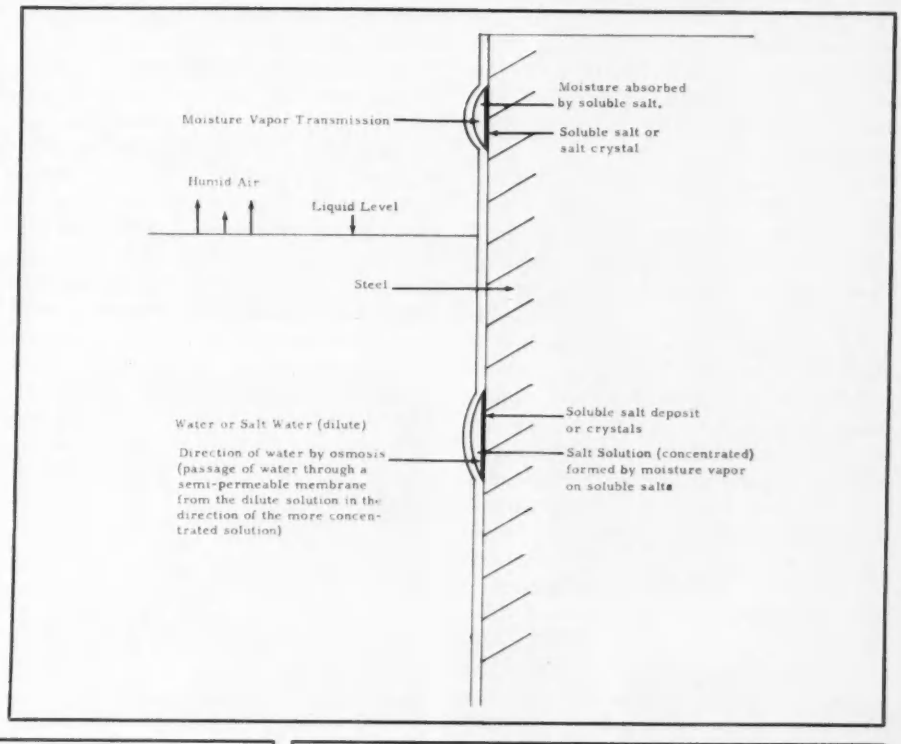
Moisture absorbed by soluble salt.
Moisture Vapor Transmission
Soluble salt or salt crystal
Humid Air
Liquid Level
Steel
Soluble salt deposit or crystals
Water or Salt Water (dilute)
Direction of water by osmosis (passage of water through a semi-permeable membrane from the dilute solution in the direction of the more concentrated solution)
Salt Solution (concentrated) formed by moisture vapor on soluble salts

FIGURE 1. Top right.

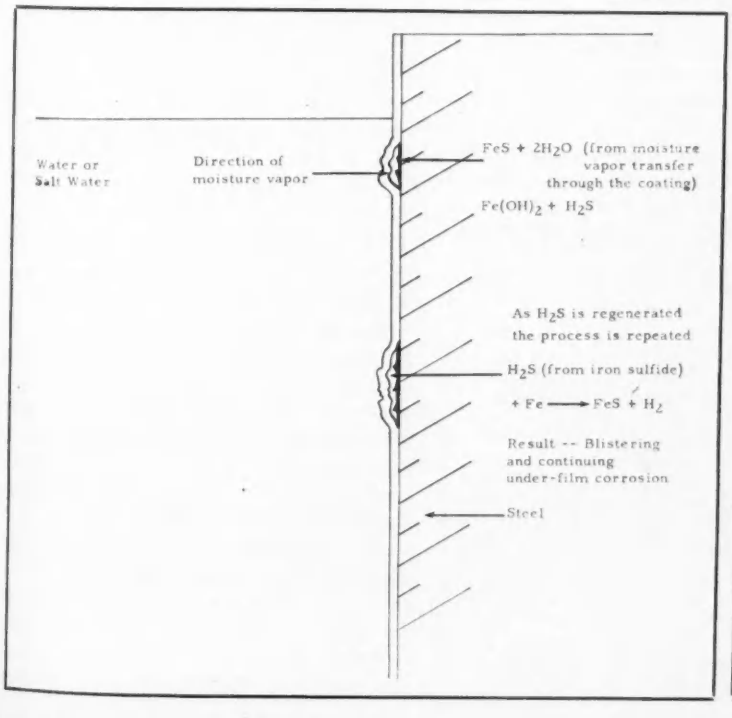
Water or Salt Water
Direction of moisture vapor
FeS + 2H2O (from moisture vapor transfer through the coating)
Fe(OH)2 + H2S
As H2S is regenerated the process is repeated
H2S (from iron sulfide)
+ Fe → FeS + H2
Result -- Blistering and continuing under-film corrosion
Steel

FIGURE 2. Lower left.

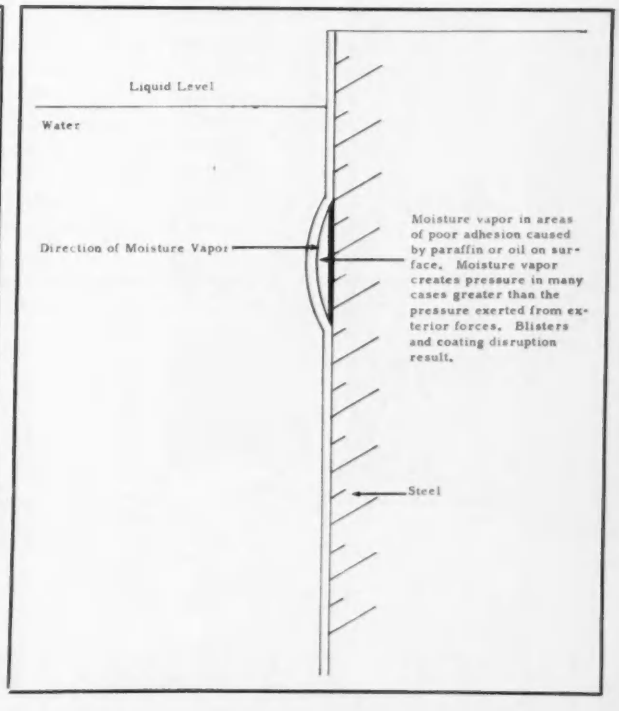
Liquid Level
Water
Direction of Moisture Vapor
Moisture vapor in areas of poor adhesion caused by paraffin or oil on surface. Moisture vapor creates pressure in many cases greater than the pressure exerted from exterior forces. Blisters and coating disruption result.
Steel

FIGURE 3. Lower right.

surface, as rust and sand become embedded therein and give appearance of the surface of the metal itself. Because of this paraffin removal is considered one of the "key" factors in proper surface preparation. The action of paraffin on a coating may be only in isolated spots, in the corners along the bolt channel, in bolted steel tanks around the bolts themselves, or along the edge of the plate. Nevertheless, the reaction in all these areas is that of poor adhesion. With an area of poor adhesion, the reaction of the coating is as shown in Figure 3. In this case it is possible for moisture vapor to pass through the film, and with poor adhesion in the area over the paraffin the moisture vapor can set up a vapor pressure greater than the pressure on the exterior of the coating is as shown in Figure 3. In form and possible rupture in the coating occur.

A fifth condition which can influence the life of a coating is the formation of gypsum deposits on iron and steel surfaces. In many cases these have extremely high adhesion to the metal, and being very hard, are difficult to remove. Should a coating be applied over such areas a reaction similar to that first described would take place. While the gypsum deposits are not readily soluble, moisture vapor will put some of the salt into solution, after which the process of osmosis can take place. The gypsum scale often is saturated with an oily deposit so that an area of poor adhesion would result with consequent blistering.

Should rupture of the film occur under any of the above conditions, continuing corrosion will result, aggravated wherever water or salt water is in contact with the area. This progressive film disruption and corrosion, under these conditions, is due to electro-endosmosis, which can be defined as the passage of liquid through a membrane under the force of an applied electric current. The direction of migration of water through the membrane is toward the pole which has the same sign as is possessed by the membrane. With an electrolyte such as salt water, an electric potential is easily set up between the coated and uncoated areas of the surface. In most cases coating films carry a negative charge; and, therefore, the passage of current (and moisture) would tend to be through the film and toward the metal. This is demonstrated in Figure 4.

In the above discussion continuous contact or immersion conditions have been assumed. Much serious corrosion takes place also in areas such as tank tops exposed to sulfide fumes in addition to weathering, and structures such as offshore drilling platforms subject to salt air and spray conditions. The effect of improper surface preparation on these surfaces would be the same as above described, although to a somewhat lesser degree. Where high humidities are common it is possible for moisture vapor to pass through a film even though the film is not in actual contact with water. Because of this much blistering and coating disruption occurs above the surface of the liquid or on tank tops subject to highly humid conditions. This reaction is similar to that demonstrated in Figure 1, except that moisture vapor from highly humid air penetrates to the soluble salt.

Preparation Methods

All these factors demonstrate the need for proper and adequate surface preparation, and the need for more than casual observation of the surface prior to the application of any resistant coating. Current methods of surface preparation are:

1. *Wire brushing and chipping*

This is very common practice, especially on marine equipment, and is a practice as old as steel ships. The action of chipping and wire brushing is one of removing the old coating, and breaking the heavy rust scale from the surface. While oftentimes getting down to solid metal free from rust scale, the surface is still contaminated by salts as well as fine rust. Following the chipping, wire brushing aids in removing loose particles, but for the most part polishes without removing the more adherent foreign material on the surface. While many coatings applied over such a surface will protect for a short period of time, no long-term protection from corrosion can be expected.

2. *Power sanding*

This method of surface preparation is becoming more common. This is an effort to do a better job of surface preparation than chipping and hand or power wire brushing. More of the hard abrasion-resistant and tightly adhering particles are removed from the surface, more clean metal is exposed, so that a better over-all preparation is received. At the same time small uneven areas in the steel surface allow the retention of scale, salts, and other surface impurities. Here, considering the under-film reactions, it is felt that no long-term protection can be obtained under even moderately corrosive conditions.

3. *Acid descaling*

Acid descaling of equipment is often possible at the source of the steel or at the fabricator's plant. It is not often possible to acid descale or etch steel surfaces in the field, as acid tanks, steam, and all of the equipment which is necessary are just not available. Under proper conditions acid descaling provides an excellent method of surface preparation. Here again, care is required, since paraffin, oil, or other materials which do not allow the acid solution to wet the surface will leave unetched areas. One advantage in this procedure is that it is ordinarily carried out hot, and as the steel plate or tube is brought out of the hot acid solution and washed with hot water, evaporation of the water from the surface is almost immediate. Where coatings are applied over a hot, dry metal surface, excellent coating results can be obtained.

4. *Sandblasting*

For field work it is believed that sandblasting is the only adequate method of surface preparation for coatings which must stand up under severe service. As demonstrated above, these coatings are adequate only where they are applied over a clean surface. Proper sandblasting will provide this surface; however, it is essential that care be taken to provide a completely gray steel surface, for if dark areas remain, especially in pits and corroded surfaces which have been in previous use, they undoubtedly contain sulfides

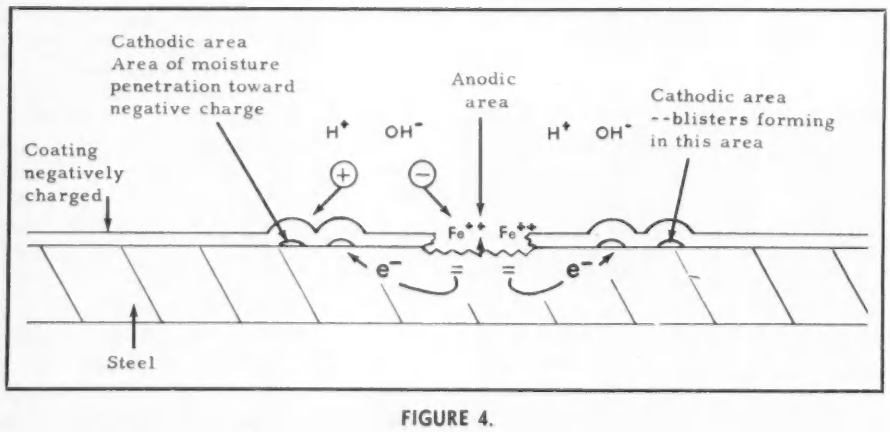

FIGURE 4.

or salts. All pits, uneven surfaces, areas along channels, around bolt heads, and lap joints in plates require special care in order to remove all foreign material. In applying coatings to the interior of casing, drill stem, well tubing, salt water disposal lines, and the like, removal of the original mill scale or the removal of iron oxide scale, iron sulfide, paraffin, or gypsum deposits requires careful inspection of the tubing and thorough blasting of the interior to provide a surface comparable in quality to the coating to be applied. When it is known that equipment has been in service where sulfides are a factor, increased precautions are required. Even though the surface is brought down to gray metal, it is still possible for sulfides and even at times paraffin to be left on the surface. In this case several procedures may be used to remove the possibility of an area of poor adhesion or continuing sulfide reaction underneath the film. Where sulfides alone are the problem it is good procedure to wash the cleaned metal surface with water and allow it to thoroughly oxidize over the entire area. This aids in oxidizing the remaining sulfides to iron oxide, which can then be removed by a second fast blasting operation. Another method, especially where high humidities are a factor and it is desirable to protect the surface of the steel from all moisture, is to flame treat the clean surface, after which it can be given a light blast to bring out the gray metal. Flame treating tends to oxidize the sulfide to iron oxide and to burn any possible oil or paraffin from the surface.

All the above surface factors, as well as the present methods of surface preparation, demonstrate in a theoretical way why proper surface preparation is an essential requirement of any coating job where difficult conditions exist. Where surface impurities are allowed to remain on the surface and severe corrosion conditions exist, under-film corrosion cannot help but take place. If, however, surfaces to be protected from salt water corrosion, electrolysis, hydrogen sulfide, and carbonic acid are thoroughly and properly prepared and highly corrosion resistant coatings used, large practical savings can be made. This results in less frequent pulling of tubing, better protection of stock tanks, treaters, and large storage tanks against leakage and continuing repair, less frequent servicing of salt water disposal lines, and reduced maintenance cost of tanks, platforms, etc. subject to severe salt water exposure. These savings far outweigh the initial cost of careful and thorough surface preparation.

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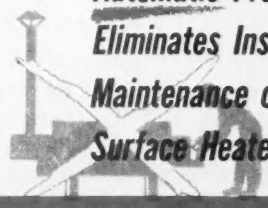

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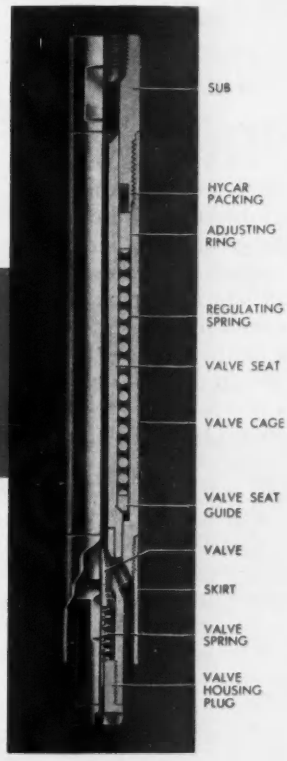

3 MANDREL ASSEMBLIES FOR DIFFERENT WELL PRESSURE CONDITIONS

Otis removable Bottom-Hole Regulators choke back well pressures deep in the string so that the travel up the tubing re-heats flow temperatures to safe, workable limits at the surface. Type DJ Regulators (J Mandrel Assembly and Landing Nipple and D Regulator) are recommended for high-pressure wells with 185°-350° temperatures. Type S Mandrel Assemblies and Landing Nipples are recommended for extra-high-pressure wells where several regulators are required to reduce surface pressures. Type B Mandrel Assembly is for wells not having previously-installed Otis J or S Landing Nipples. Contact one of these Otis offices for complete details . . .

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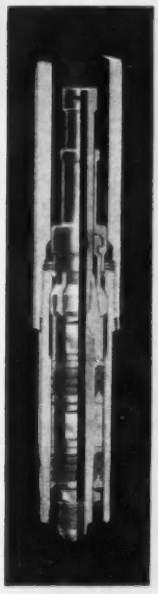
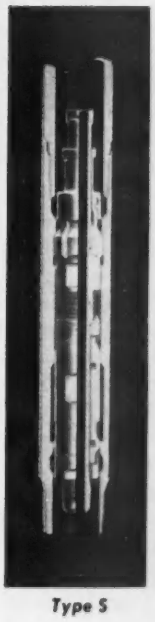
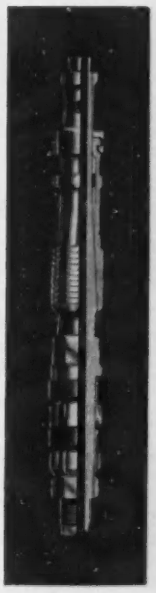
Victoria, Odessa, Falfurrias
Longview, Oklahoma City
New Iberia, La.; Houma, La.
Brookhaven, Miss.; Los Angeles
Bolivar, N. Y.; Caracas, Venez.



Type J



Type S



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PRESSURE CONTROL OTIS SERVICE – EQUIPMENT

Sharp Growth Boosts Pumping Equipment Sales

By WARREN L. BAKER
Editor

A VERY sharp increase during recent months has boosted current sales of oil field pumping equipment considerably above volumes which existed last year, and peak drilling and crude producing rates should cause purchases to remain at high levels for some time unless insufficient steel retards manufacturing or causes a severe reduction in drilling operations.

In a newly completed survey made by WORLD OIL, all manufacturers reported that current sales are running from 20 percent to almost double those of a year ago. Oil companies agreed that their purchases of pumping equipment were considerably larger than in 1949. Whereas sales in 1949 were heavy during the first part of the year and then tapered off during the second half, just the reverse is indicated this year. Following poor sales volume during the first quarter of 1950, there has been a steady increase since March and an especially large gain since June. While all manufacturers said sales in recent months have been much higher than in the same period of 1949, a minority reported that first half year business was not equal to the corresponding period of last year due to lagging sales in the first quarter. However, the majority reported sales in the first 6 or 7 months of 1950 exceeding 1949 volumes.

If sales follow the expectations of most manufacturers and remain high, there will be a continually larger spread between 1950 and 1949 sales volume during the remainder of the year because of the low rate which existed in the second half of last year.

In its annual forecast made early in 1950, WORLD OIL estimated that slightly fewer wells would be equipped with artificial lifting equipment (pump or gas lift) than in 1949. However, the current survey indicates that estimates on 1950 pumping equipment purchases now must be revised upward by a substantial amount.

So great has been the increase that some difficulty is being experienced in obtaining immediate delivery. Although at the beginning of the Korean War three months ago most manufacturers were able to make deliveries within a week or two, various concerns reported they now are 35 to 90 days behind. A few anticipated further delay in deliveries, foreseeing more difficulty in procuring enough steel along with an additional growth in purchases.

Causes Behind Increase

The increase in demand for pumping equipment undoubtedly is the result of several factors. There is some forward buying as protection against inflationary prices and wartime scarcity, but the industry's higher drilling and producing rates make it apparent that there has been an increase in the actual need for such equipment.

It is difficult to determine how much influence the war, and its consequent possibilities of price advances and a steel shortage, have had; therefore, opinions differ as to the amount of forward buying. Some feel that there has been a substantial amount of forward buying, but others are inclined to think this has been a small factor.

Apparently the most important influences have been improved conditions within the industry, where unusually sharp growth in demand for petroleum has resulted in increased production rates and firmer crude prices, which have combined to encourage expanded drilling operations.

Unquestionably, enlarged producing rates have had a strong bearing on the purchases of pumping equipment, causing faster reservoir pressure declines and thereby hastening the installation of artificial lift equipment. The ready market for greater quantities of oil in recent months, plus the firming of crude prices, also have prolonged the operation of some properties which for economic reasons might otherwise have been abandoned or shut in. For instance, with the war bringing an enlarged demand for heavy crude there has been a scramble in California to re-equip such wells, many of which had been stripped of pumping units because little heavy crude was wanted during the past several years. Furthermore, several price advances in Pennsylvania crude have enlarged water-flooding operations in that area.

The high rate of drilling also has reflected favorably on pumping equipment requirements. The first seven months of this year saw 13,627 new oil producing wells completed, a gain of 1427 over the same period of 1949. Some of this growth has been in predominantly pumping regions. Extensive drilling has taken place in some old areas where wells immediately go on the pump, such as Seminole (Oklahoma) and Trapp (Kansas).

Good Future Sales

The majority of replies to the survey expressed the opinion that pumping equipment sales would remain very good for some time, further increases being anticipated by many and only a few expressing the thought that shortage of tubular goods would limit drilling activities and thus reduce the number of new wells completed. However, all expressed concern over the ability of manufacturers to get enough steel to meet demand. Steel already is causing some manufacturers occasional spot difficulties.

Even those who feel that re-equipping of old wells and forward protection buying will taper off think that buying volumes will remain above normal as long as the demand for petroleum products continues high. Of course, high drilling activity, unless accompanied by large consumption of oil, would reduce per well allowables and thus in the long range delay the installation of lifting equipment by extending flowing life. However, such a condition seems unlikely in view of all signs indicating further growth in petroleum requirements.

Well-Plugging Techniques

■ CONTINUED FROM PAGE 171

establishes a blocked or segregated area, within the confines of which considerable oil is trapped. If fluid pressured into the area is water instead of oil, the repressuring agent will eventually channel around it, leaving many sections flooded, or bypassed entirely. A very limited number of such areas, if at strategic points on a property, can upset an oil recovery program, and complex problems arising therefrom reveal the timely and very urgent need for plugging materials which are better adapted to present oil recovery methods.

Considerable exploratory work in sand plugging is now being conducted with plastics, plastic compounds, resinous compositions, wax emulsions, and chemical dehydrating agents; the latter being used to plug capillary pores along a sand face. Many of these materials, especially the plastics, have already proven their value in sealing off water strata in producing wells. By similar methods of application, the same desirable effects could be obtained upon abandonments were not the costs prohibitive. A greater number of formulas, plus increased production, are lessening the costs to some extent, but mainly the obstacle is being overcome by the fact that such agents are adaptable for use as supplements to increase the effectiveness of common and less expensive materials. Present rate of progress now indicates that within the very near future the supplementary use of plastics, waxes, resins, etc., will convert common clays, road-chat, drill-cuttings, paraffin sludge, and other waste products into satisfactory pluggings for abandonments. Partial sand-face sealing has been accomplished in many cases with gel compounds, prior to plugging, and chemical combinations are now being designed for spraying the interior of shot holes for permanent pore closing. In certain districts, and in selected cases, combinations of more common agents have given excellent plugging results, principal mixtures being gel and wood pulp; putty, and powdered cork with clay; cement with lime; and wheat flour with lime and clay. Another promising procedure, now undergoing field tests is to induce Jamin (oil-water) actions which are localized within the sand face area before the plugging filler is introduced. Considerable study is also being applied to certain types of bacteria, algae, fungus growths, and with various smokes and gases, as aids in sealing abandonments. To all such possibilities, the field is and will continue to be wide open because in many areas, abandonments far outnumber well-completions, and every questionable plugging job is a potential risk to an oil reserve.

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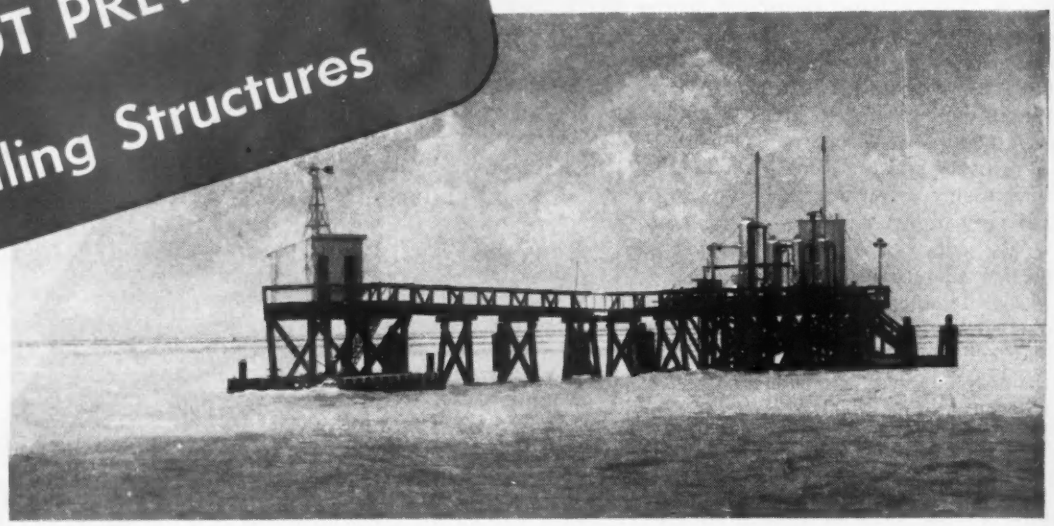
DRY ROT PREVENTION in Piling Structures



USE OF TIMBER ELEMENTS in offshore structures emphasizes the need for thorough protection against deterioration of the timber from within, despite its being surrounded with salt water and thus apparently insured against any tendency toward drying out. This article reviews some of the methods employed to protect exposed timber butts, enabling them to give the service which should be secured when properly protected against marine life and wave action.

By ELTON STERRETT

Engineering Editor

CREOSOTED piling, widely used for supporting drilling and producing structures in the offshore and marshland operations of the Texas and Louisiana Gulf Coasts, frequently deteriorates through internal dry rot. This condition may continue unnoticed until the entire center or core of the pile has been reduced to a dry dust or an equally unsubstantial mass of skeletonized wood fiber which will disintegrate if stressed.

The creosoting treatment given the pile before delivery to the job may be as good as best practice can obtain, and the timber be saturated with the preservative until no more can be added. But, if there be no steps taken to maintain this condition, the user can have no assurance that the protection he bought will stay on the job.

The nature of the wood pile itself is in part responsible for this trend toward failure. When the stripped pole is processed, it is dried, moisture extracted as far as possible, and under either the vacuum process or the pressure treatment, creosote is made to replace the moisture and fill the voids between wood fibers. The outer portion of the pile dries first, and the harder, more firmly knit heart section yields its moisture more reluctantly. Since it is not feasible commercially to continue the drying process indefinitely, there is always residual moisture within the heart wood even when the outside layers have been thoroughly impregnated with the preservative.

Since a driven pile is buried for a portion of its length in mud, sand, silt or other saturated material of the bottom, evaporation through this portion of the timber is halted. Likewise, if the creosoting process is properly carried out, the sap wood of the pile is filled with a moisture-resistant liquid. The effectiveness of this preservative treatment is demonstrated by the long life of piling driven in positions exposed to severe weather, tidal or even wave conditions.

The driven pile is unchanged from its state as delivered by the creosoting plant insofar as the driven tip and sides are concerned. Only in rare instances is the point sharpened, and only incidental alterations are made along the sides of the unit. But the butt or top, exposed to the battering of the pile-driver tup, is nearly always cut off to remove the broomed end. Or, if the end is protected by a driving sleeve, cap or head, it is necessary to cut off the pile to bring it level with others in the group or cluster. When this is done, the end fibres of the timber are exposed, and the difference in color between sap wood and heart is readily apparent in the lighter shading of the preservative in the latter.

Unless the ends of the piles, after cutting to elevation, are given adequate protection, this open end of the heart section will allow the unit to "breathe." Dampness or sap retained within the pile at the time of treatment will gradually work out through the open end, allowing more and still more of the residual moisture to escape. As the heart wood dries, it is exposed to the ravages of fungi which, present everywhere, need only the presentation of favorable conditions to attack the wood and gradually to reduce it to dust or a spongy mass of brittle fibers.

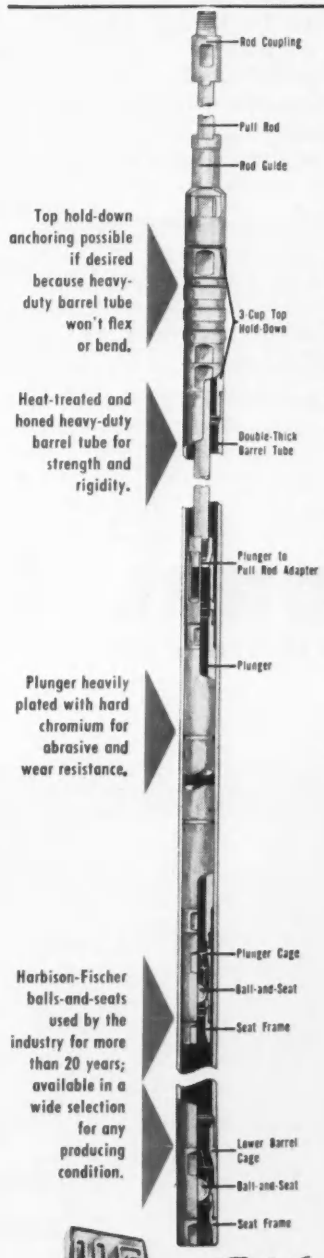
Capping the butt ends with metal, according to tests conducted by various technical societies and marine interests, is of little use. The cap, while slowing the dissipation of moisture from within the pile, likewise prevents its renewal through rain, and also shuts off the sunlight which otherwise might tend to delay fungi propagation. The usual galvanized cap or the similar covering fashioned from sheet lead and nailed around the top of the pile allows the dry rot to go on undisturbed. Frequently the disintegration of the pile is unnoticed unless concentrated loading at the center of the pile top causes the metal sheath to give way and expose the damage. Use of copper for the cap is slightly more effective, probably due to the somewhat toxic effect which copper salts have on some of the fungi tending to attack the wood. Cast iron caps, used in a number of wharf installations to protect pile butts against rot and to distribute the loading, likewise fail to protect against the invasion of fungi. The caps, rough cast, cannot seat perfectly on the pile end. Thus they fail to provide the seal necessary to prevent evaporation and at best can serve only as mechanical protection against abrasion of the timber.

Coating the pile end with heavy coal tar or bituminous material is of little use, because of the failure of the creosote and other preservative to unite and form a homogeneous seal. The same drawback applies to attempts to cover the pile butt with paint of either the oil-vehicle or plastic-base type.

Experimental periodic renewal of the creosote in the pile butt with similar liquid, poured on the exposed wood fibers and allowed to penetrate as far as possible under gravity pull and capillary attraction has been found to be useful. It at least delays the propagation of the destroying fungi. If the exposed heart wood is in the open where the creosote can be applied and observed, it has been found that annual or even biennial application will afford protection unless the pile be driven in an area where extreme dryness of the atmosphere is encountered, or where other conditions accelerate evaporation of the preservative.

For pile ends carried under beams or otherwise enclosed in a structure—as on a bay or marsh production platform—several means of conveying the creosote to the exposed wood fibers in the end of the pile are being tried. One method involves the use of a small copper pipe carried down through the intervening structure to the pile top; a small grease cup being countersunk in the overlying beam and sweated to the end of the pipe to provide a convenient funnel for pouring the creosote and to provide a small reservoir for feeding until the supply is exhausted. A refinement on this process involves a ring or band of galvanized iron or copper, pressed or forced into the end fibers of the pipe and allowed to protrude from ⅛ to ¼ inch. This ring, with a diameter about half-way between that of the heart wood and the outside diameter of the piling, is placed just before the overlying timber is set, and is forced by the weight thereof into the end fibers. At the same time it forms a dam or confining seal to prevent creosote fed to the top of the pile from escaping on the low side or if a check crack develops.

Wicking or other fibrous material applied over that portion of the pile end not occupied by the overlying structure has also been tried as a means of providing replenishment of the preservative in the pile butt. If the overlying beam fits closely on the pile end, this method provides fluid which feeds, by capillary action, toward the center of the pile. But if the bearing is not uniform, or the pile end is not cut off exactly square, much creosote is lost and the efficiency of the wicking method is much impaired.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Field Testing and Servicing of *Indicating Pressure Gauges*

By JAMES O. KREBS
Southeastern Public Service Company
Charleston, W. Va.

THE following brief outline of experience relates to practical knowledge, acquired over a period of a little more than three years of testing and repairing indicating pressure gauges. This article is limited to bourdon tube spring gauges, ranging from 30 to 1000 pounds. Electrically controlled gauges, vacuum gauges, compound gauges, and extremely low pressure (ounce) gauges are not included. All gauges described are used to measure gas pressures.

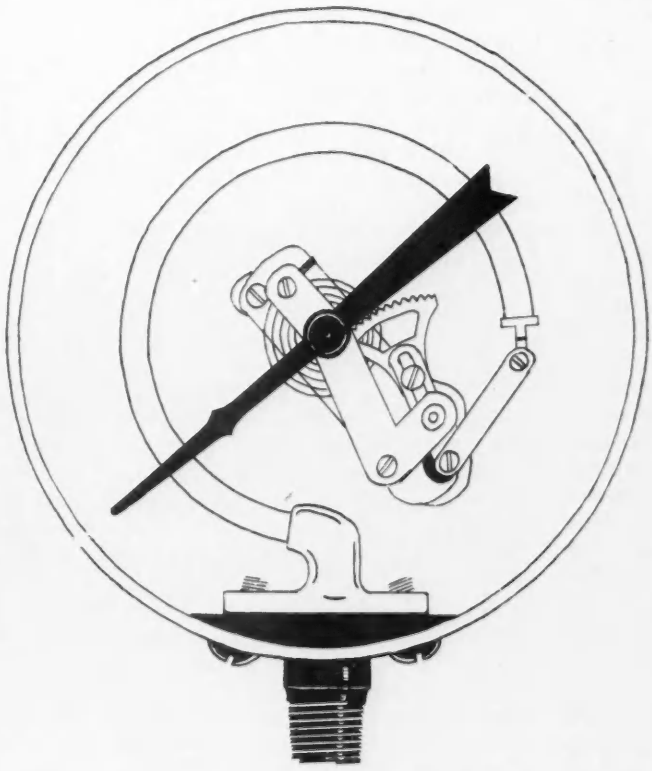
Early in 1947, my company authorized me to number and check indicating pressure gauges then in use. This included gauges being carried by men in the field, as well as stationary gauges. The idea was to check all gauges with a dead-weight tester, making such tests in the field rather than to have the gauges transported to a central location. Since transportation would have been via parcel post in the majority of cases, possible breakage, due to rough handling in transit, has been avoided. Also this practice has kept in continuous operation gauges which, otherwise, would have been out of service at least a full week.

The area of operation is relatively large, necessitating some trips of more than 200 miles, one way, but it has been proved that testing in the field has a definite advantage. Since the schedule called for checking certain predetermined areas at definite intervals, gauges which might have been used, unchecked, over long periods of time due to negligence on the part of the user have been checked periodically. Gauges, which were unfit for service and beyond repair have long since been discarded, preventing field men from inadvertent use of such a gauge. Testing in the field has also provided an opportunity to talk directly with the man in the field, enabling each of us to profit by the experiences of the other.

One thing in particular I have come to know and respect concerning small pressure gauges: that a pressure gauge is a delicate instrument, deserving the consideration normally accorded a fine pocket watch. Gauges hold a place of importance in the gas industry and are instrumental in the many decisions which must be made concerning pressures and measurement, gas reserves and production calculations. Their duties are many and varied, and they are relied upon to be accurate, even though often subjected to extreme changes in climatic conditions; therefore they are deserving the same care and maintenance bestowed upon larger and more elaborate equipment.

Even though a small indicating pressure gauge is a relatively simple mechanism, containing few parts, a number of minor troubles cause inaccuracies.

The bourdon tube was invented by Louis Bourdon, and from him, derives its name. As defined by Webster, a bourdon tube is "A manometer consisting essentially of a blind curved elastic tube, oval in section, open at one end to the gas, steam, etc., whose pressure is to be registered. A variation of pressure in the fluid causes anticlastic bending of the tube." A pressure gauge using the bourdon tube principle is simply as described above with the blind end of the tube attached, by such mechanism as is necessary, to actuate a pointer over a calibrated dial. (See diagram.)



Pressure gauge employing bourdon tube principle.

Spring or tube fatigue is the greatest cause affecting the accuracy of a bourdon tube gauge. This occurs when a gauge is subjected to the same range of pressures over long periods of time. The spring takes a "permanent set" in a specific range and is easy to re-calibrate in this particular range, but is usually high at lower ranges and low at higher ranges. The writer's practice has been to re-calibrate such gauges according to the range to which it is accustomed and in which it is being used, providing the entire range of the gauge can be run within 5 percent accuracy. To so calibrate a gauge, determine the first low point of inaccuracy and the first high point by testing. With the gauge mounted on the tester, run pressure on the tester equal to the halfway point between the high low points as already determined and set the gauge pointer to the pres-

sure indicated on the tester. Placing the pointer on the staff while the gauge is under pressure at this halfway point will have a compensating effect for the extreme high and low, thus placing the gauge as nearly accurate over-all as possible.

Dirt, oil, and dust are the most annoying causes of gauge troubles. Even minute particles of dirt lodged in the cogs of the pinion and sector cause a gauge to falter and jump. This condition can be corrected by removing the nuisance—dirt. A tooth brush and a very small brush with flexible brass bristles may be used to clean these cogs. After removing the dirt, parts should be wiped free of any accumulation of oil and lint with *clean* cloth before re-assembling. While the gauge is dismantled for cleaning, the bearings should be checked for friction. The staffs which couple the levers or tangents can sometimes be bent very easily, preventing the friction-free movement necessary for accuracy, especially when the instrument has been subjected to unusually rough treatment, such as accidental dropping or having been hauled over rough terrain without the protective covering of a leather case, causing these points of friction to freeze the gauge. Before assembling the gauge for the final calibration, wipe out the inside of the case, taking care to remove all dirt and grease which might have accumulated there. This precautionary measure may save time during the next checking period by preventing that accumulation of dirt from eventually finding its way into the working parts of the gauge.

Hairspring Trouble

The hairspring is another source of gauge trouble. This spring should take up any lost motion caused by loose bearings and keep the pointer tight. Often this spring loses tension, or may become entwined in itself, causing it to bind the pinion. I have no recommendation concerning the treatment of entangled hairsprings, although I have taken them loose at one end and cut off the entangled portion. Many gauges have this hairspring attached to one of the posts supporting the mechanism. This spring is held in place by a steel pin driven into the post, forming a wedge against the end of the spring. This pin can be removed and the entangled hairspring straightened.

Pointers which ride high on one side of the dial and low on the other indicate two things. Either the pointer is bent or the supporting staff is bent. Each can be a source of trouble. The pointer should clear the dial sufficiently to enable it to pass freely over the screwheads which secure the dial, but should not touch the gauge glass. Pointers should always be removed with the aid of a hand jack to prevent bending the staff. A minor source of irritation, easily corrected, which I have brought to the attention of the field men, is the fact that the screws which secure the bourdon tube to the inside of the gauge case often become loose. This creates a slippage or wobble causing the gauge to be off zero, and according to the position in which the gauge is mounted for reading pressures, can cause either high or low readings.

Trouble is sometimes encountered in re-setting the pointer after a gauge has been adjusted. I have formed the habit of setting the pointer while the gauge is under pressure. If the gauge has been calibrated correctly, the pointer returns to a perfect zero when pressure is released. Setting the pointer accurately is accomplished in stubborn cases by setting it, as closely as possible, to the correct reading and then loosening the screws which hold the dial in place, so that the dial can be moved enough to compensate for the difference. Slotting the screw holes slightly will allow more flexibility for this correcting operation; however, pointers which are equipped with an adjusting micrometer do not need this added flexibility.

Most gauges need only minor adjustments to place them in accurate calibration. Our gauges are practically all made with adjustable tangents attached to the sector, which permits lengthening or shortening as the need arises. Gauges found to be slow should have this tangent shortened and vice versa. The trial and error method has to suffice while re-calibrating a gauge, but after experience, two or three settings generally result in an accurate adjustment.

Bourdon tubes sometimes become packed with dirt or sludge when gauging a well after bailing or swabbing. This sludge is blown directly into the tube and unless it is removed will affect the accuracy of the gauge. A grease-dissolving solvent poured into the tube usually relieves this situation.

We are now replacing broken gauge glasses with clear plastic, such as Lucite. This plastic is manufactured in various thicknesses and is easily cut to size with a coping saw. With the aid of emery cloth and rasp, it is readily sized and fitted. Care should be exercised in replacing gauge glasses so that they fit properly. Loose, ill-fitting glasses permit dust and dirt to accumulate inside the case, obliterating the dial as well as being a source of trouble to the mechanism.

Repair Parts

Discounting a few essentials, all repair parts carried in my outfit have been salvaged from broken and discarded gauges. Gauges which require major repairs should be returned to the factory, thus eliminating the need for stocking many repair parts. Screws, gauge glasses, gauge covers, pointers, and tangents comprise most of the parts desirable to salvage from discarded gauges.

It is advisable, if gauge connections are not constructed to receive a wrench, to equip such gauges with an adapter or "sub." This prevents gauges from being set up by grasping the gauge case, placing strain on the screws holding the bourdon tube in place and causing the pointer to be twisted off zero. Field men should be cautioned regarding this practice.

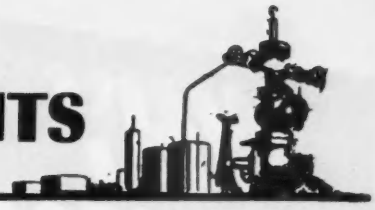
The dead-weight tester and accessories used is a portable outfit, weighing approximately 50 pounds inluding the weights. It has 5-pound graduations and tests from 0 to 1000 pounds. The tool kit consists of pliers, pointed pincers, small crescent wrench, small pipe wrench, wire brush, tooth brush, clean wiping cloths and an assortment of screw drivers. Necessities for numbering gauges are also carried.

Listed are findings relating to the causes of inaccuracies of indicating pressure gauges:

Spring or tube fatigue, dirt, dust and oil, packed or clogged tubes, twisted hairsprings, bent staffs, friction in bearings, tubes loose in cases, bent pointers and insecure dials. These items comprise most of the troubles to look for which can normally be corrected in the field.

The writer has followed a predetermined schedule in testing and repairing gauges, whereby each gauge is scheduled to be checked each six months, and more often when warranted. Gauges will usually check, with but few minor adjustments, when tested according to this schedule. The records kept on each gauge are readily accessible and provide an accurate record of all tests and repairs made during the past three years. In adition, the location, kind, range and use of all gauges is a matter of record. By and large, testing indicating pressure gauges in the field has greatly decreased the use of inaccurate gauges and increased the value of the records received from the field.

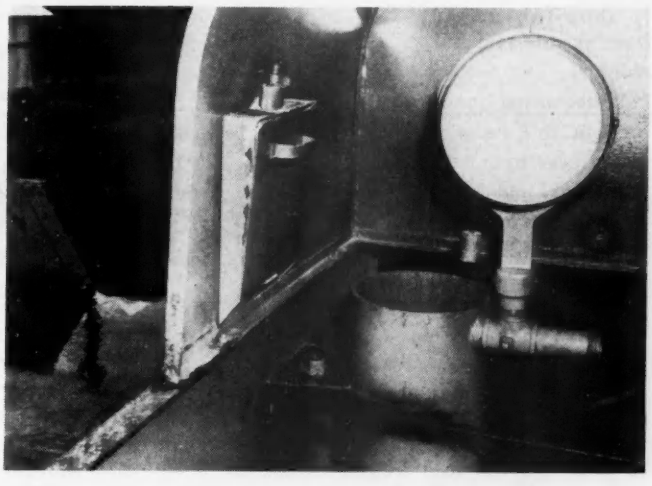
PRODUCTION HINTS



$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas

HOW TO—Record Flow of Liquids Over Weir Meter

Simplicity of the weir meter in measuring flow of fluids has brought about its utility in many places in the oil industry. Accurately recording the flow is a problem, however, since the volume passing over the vee varies with the height or crest of the liquid above the bottom of the vee. Here is an adaptation made to measure fairly accurately the volume of water feed-into a salt water disposal system.



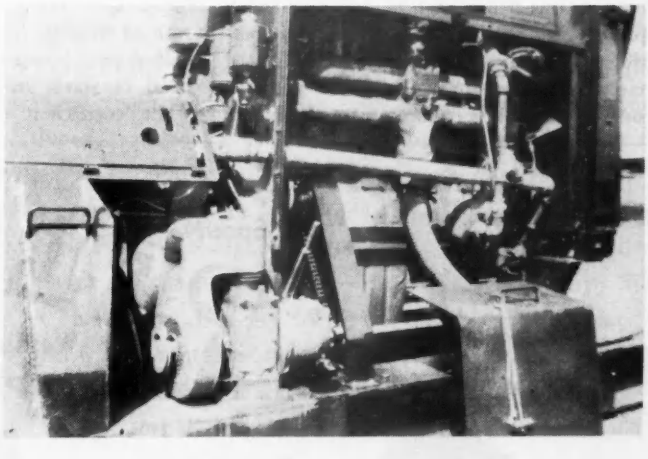
The weir box itself is approximately 8 feet long, 4 feet wide and 4 feet deep, with the calibrated weir vee notch in one end. Beside the weir box is a piece of 7-inch casing sealed at the bottom end and connected to the weir box through a piece of two-inch pipe. The vertical casing section extends to the top of the weir box. The casing serves as a guide chamber for a float resting on the water in the casing, which represents the water level in the weir box because they are interconnected.

A time clock recorder is mounted to the top of the casing by means of pipe and fittings as shown. This 7-day clock records the rate of flow in terms of barrels per hour. By integrating the finished record, and multiplying by the time, the total volume of water passing over the weir meter during the 7-day period can be calculated. The meter is actuated by a small pulley mounted on the rear of the meter housing. A steel wire attached to the float in the casing is passed over the pulley and counterweighted at the other end to maintain a taut wire.

A walkway paralleling the weir box makes it convenient to construct a protective housing for the meter. Inside the bonnet-type metal housing is mounted a case wherein are kept blank charts as well as ink to refill the meter pens.

HOW TO—Rig Power Starter for Central Pump Unit

On a central pumping unit operating several wells on a lease in Illinois, a medium-sized drilling engine was converted as the prime mover and was mounted on a skid with the transmission and eccentric pulley. The engine was formerly equipped with a 12-volt battery starter which posed a battery problem, and it was desired to install a power starter.



A 4 to 5 horsepower gasoline-driven, air-cooled engine was available and was used as the power for the starter. The small engine was equipped with a clutch so the starter could be engaged or disengaged by the clutch at will. The spring-type starter mechanism formerly used with the electric starter was modified by adding a sprocket to the outside of the housing and including a shaft bushing for the starter shaft.

A similar sprocket was coupled to the output shaft of the smaller engine clutch by a converted automobile axle. To balance the load on the driving sprocket, the shaft was extended and terminated in a shop-made pedestal bearing. Bore for the bearing in the end plate was .001 inch smaller than the bearing. The shaft was made .001 inch oversize. With this tight fit, there was no need for a plate to hold the bearing in the end plate.

The roller type driving chain was fitted with a guard to protect the operator. A sheet metal cover was shaped to fit over the small gasoline engine to protect it from the weather. This unit is shut down at least once a day, and the power starter described has proved satisfactory in more than 2½ years of operation.

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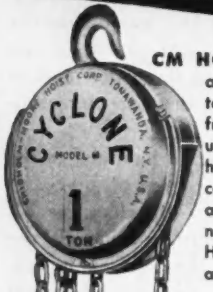

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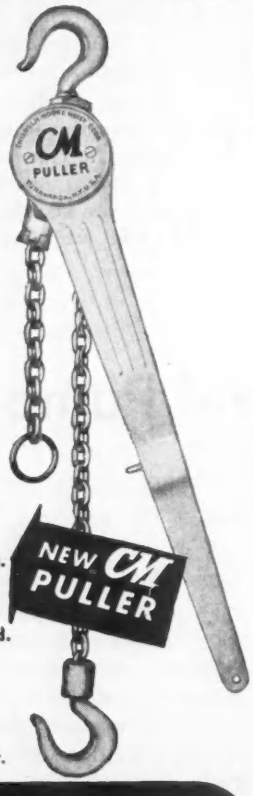

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PRODUCTION HINTS

HOW TO— Gauge Water Production

—Courtesy *Pumping Trends*, Kobe, Inc.

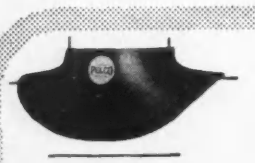
When it is desired to make a rough measurement of water production from a well or lease, the job can be done without a large investment in metering devices. The apparatus illustrated is shop-fabricated from readily-available material.

Water being measured in this instance discharges from the wash tank, and is not excessive. It is merely dumped into a large evaporation pit situated at a lower elevation than the wash tanks. The measuring device shown is located at the pit where sufficient head develops in the large vertical chamber to form a basis for metering.

The device is simply a convenient means of measuring the head above a known size orifice. The head of water is a function of the discharge rate, and with a sliding indicator on the side of the gauge tank, the approximate rate of flow can be determined. The rate of flow multiplied by the time factor, of course, gives total volume during that interval of time.

The gauge tank is a 4-foot section of 14-inch casing sealed at the bottom and open at top, but fitted with an overflow connection which spills into the discharge trough. A flange plate fitting is welded to the bottom of the gauge tank, and the orifice drilled in a ¼-inch steel plate that bolts to this flange. A float and float guide placed inside the gauge tank make it possible to measure the height of water in the tank. A gauge stick fastened to the outside of the tank is calibrated for the orifice used, but several different sizes can be used provided they are calibrated. In fairly rough figures, four feet of head on a ½-inch orifice will provide a flow rate of 200 barrels per day; on a ¾-inch orifice, the flow rate will be about 450 barrels per day; and on a one-inch orifice, flow will be about 800 barrels per day.

To handle larger volumes of flow without changing orifice plates or installing new calibrated rules, more than one of a given size orifice can be drilled in the orifice plate. Those holes not in use can be plugged with cork stoppers or other suitable means. The rate of flow when more than one hole is open is determined by multiplying the rate indicated on the calibrated rule by the number of orifice openings. The rate indicating scale may be layed out by using the following formula: $Q = 524 \times a \sqrt{h}$; where Q is the rate of flow in barrels per day, a is the orifice area in square inches, and h is the head of water in feet above the orifice. (The coefficient of discharge is 0.610.)



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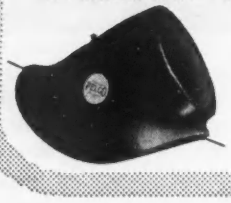

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The harder you are to please, the better you will like these gauges that are engineered down to the last detail for every service encountered in the oil industry. In the Marsh Mastergauge you have an instrument guaranteed accurate within ½ of 1% of reading—a gauge with a finer monel and stainless steel movement, lathe turned bourdon tube and moistureproof, vaporproof case—a gauge that sets a new standard for quality and stamina.

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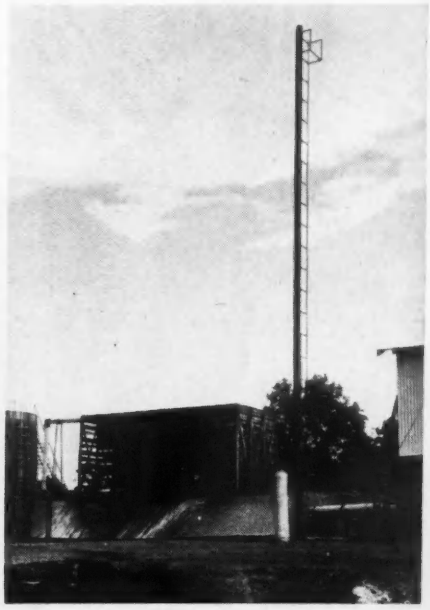
HOW TO— Protect Chlorine Vessel from Salt Water

Disposal of salt water by injecting it back into the formation below the water table requires that the water be free of plugging agents in either organic or inorganic form. Suitable filters are capable of removing foreign matter in the solid form, and certain chemical treatments have been successful in causing precipitation of undesirable constituents that cause plugging. Considerable difficulty has been experienced with the growth of algae in water being treated for disposal. Algae growth clogs up filters and brings about untold trouble in salt water disposal plants. An



effective agent in killing algae before it gets out of hand has been chlorine gas. This gas, permitted to bubble into the salt water as it is fed into the settling ponds dissolves in the water and retards plant growth.

In many such treatments, bottled chlorine gas is used, and the flow of gas into the pond is controlled by a small pressure regulator. If the bottle exhausts itself and is permitted to remain out in the weather, heat expands the gas and drives out most of it. During the night, the bottle becomes cool and the flow of gas is reversed, causing the salt water to be sucked up into the pressure vessel. Unless the steel bottle is immediately cleaned, it will rust and become a hazard.

To prevent such an occurrence a barometric leg was erected in the small flow line connecting the bottle to the discharge point in the pond. This barometric leg, an inverted "U" section in half-inch pipe, extends 35 feet above the pond level. It is supported by an equal length of heavy pipe set in concrete, on which is mounted a steel ladder made of sucker rod material. Even though the bottle becomes empty and remains unattended for more than 24 hours, the vacuum created by the temperature difference can not suck the salt water over the 35-foot level, which is equivalent to more than the barometric pressure at this elevation. The barometric leg has proved itself many times by keeping salt water out of the bottle.

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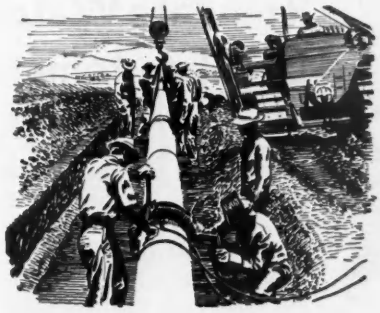
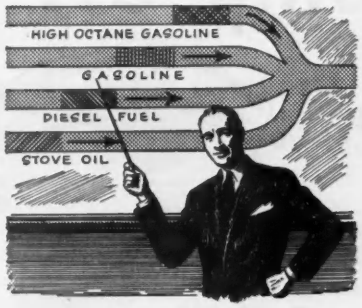
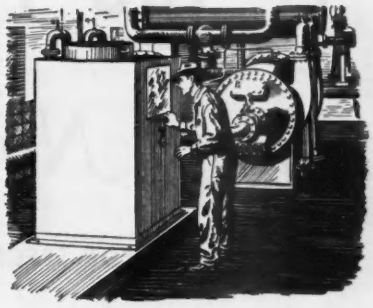
Standard develops peacetime use for atomic energy



Salt Lake Pipe Line Company (a Standard Oil Company of California subsidiary) is completing a 566-mile pipe line between Salt Lake City and Pasco, Washington. The line will serve many points with a variety of petroleum products.



How could these products be kept separated...products ranging from diesel fuel to high-octane gasoline ...as they follow each other through this common carrier line? This problem has been solved efficiently by using atomic energy.



Each time a change to a new product is made, very minute amounts of radioactive tracer material are put into the line... tracer material prepared especially for this use in the Government atomic pile at Oak Ridge, Tennessee.

Using a Geiger Counter, operators at the destination can tell exactly when the radioactive tracer arrives in the pipe...and they can switch the new stream of gasoline or oil into the proper tank. The radioactive tracer is so diluted in each batch of products that only the recording made by a Geiger Counter can tell you it's there. Its radioactivity will be far less than that of a luminous watch dial.

This is one of the first commercial uses of atomic energy in American industry. But it won't be the last.

Our scientists...and those of other companies... are fast learning how to make this great development work for peaceful purposes. You'll see the results of this knowledge soon...not only in improved methods of transportation but in new and useful products.

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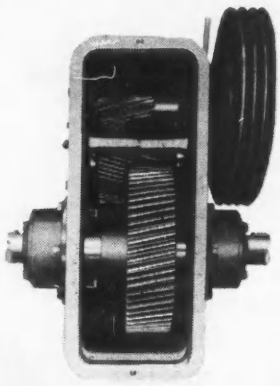

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ALTEN

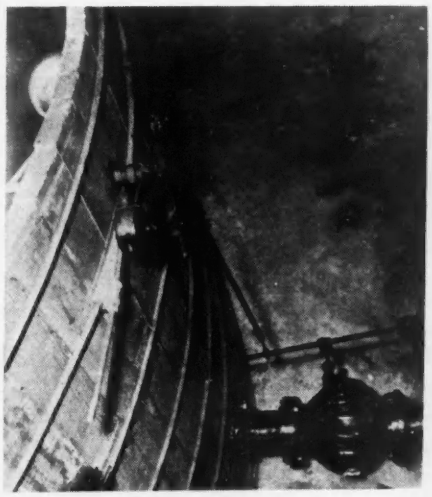
PRODUCTION HINTS

HOW TO—

Regulate Water Tank Level Automatically

Some salt water injection wells take water under a vacuum instead of having fluid pumped into the formations. Here is a method of automatically maintaining a constant level or head of water in a supply tank feeding into the injection well.

Because the treating plant is on a higher elevation than the injection well or the tank shown, a constant pressure due to gravity exists in the large supply line shown at lower right. A lever-controlled regulating valve installed in this line permits the flow of water into the tank when the level drops, but stops the flow when the water level reaches a predetermined point.



A mechanical linkage controlled by a floating stainless steel ball actuates the regulating valve. A bushing inserted in the wooden tank near the upper edge accommodates a shaft attached to a lever inside the tank. The float is mounted on the end of the lever. On the outside of the tank, the shaft is threaded and a bolt holds a counterbalance arm tightly in place. An adjustable weight is placed on one end of the arm, while the other end is attached through a turnbuckle to a vertical linkage which is in turn connected to the valve control lever. There are several points of adjustments that can be made. The counter weights can be moved, or the length of the connecting link can be adjusted to provide the proper movement of the regulator arm.

As the well takes water, the float is lowered, causing the shaft to turn and thereby pushing the control lever on the regulating valve downward. This movement opens the valve and water is permitted to flow in the tank until its level reaches the height at which the valve closes.

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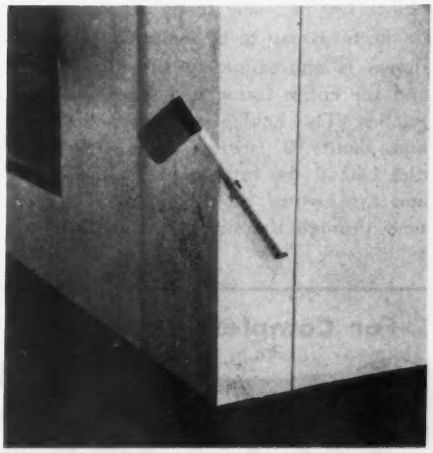
PRODUCTION HINTS

HOW TO—

Signal Gauger at Lease Tank Battery

When the pumper in charge of oil producing leases which are far apart is making his rounds of each tank battery and wells, it is just a coincidence if he should meet the pipe line gauger at a tank battery that is ready for the pipe line. In many cases, the pipe line gauger must park his truck and walk up to the tank battery to determine whether the tanks are filled and ready for shipment. On many leases spread out over a large area, the gauger can waste valuable time just in making these simple checks. Because it is

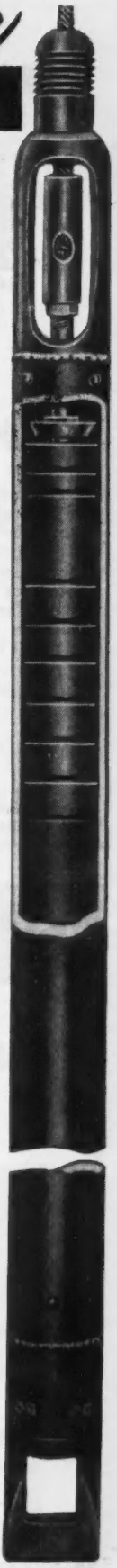


always necessary for the pumper, who is the producing company's representative, to make his gauge before releasing the oil to the pipe line company, the pipe line gauger must have the pumper's approval before breaking the seal on any tank and taking out the contents.

A simple devise used by one company has saved the pipe line gauger considerable time and has facilitated his job. By means of a signal, the pumper indicates to the pipe line gauger that there is a tank (or tanks) of oil ready for the pipe line at the tank battery where the flag is displayed.

The device is a small wooden flag and staff in which slots are cut for mounting on the side of the pumper's dog house at the tank battery. In the position shown, the flag notifies the gauger passing in his truck that one or more tanks at the battery is ready for movement. After the oil is moved from the tank and the gauger is ready to go to the next battery, the flag is hung alongside the building so that the red flag portion hangs down and out of sight from the road. This idea has saved the gauger many useless stops.

Miller
SAND PUMPS



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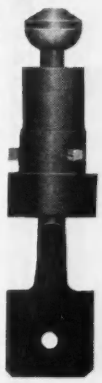

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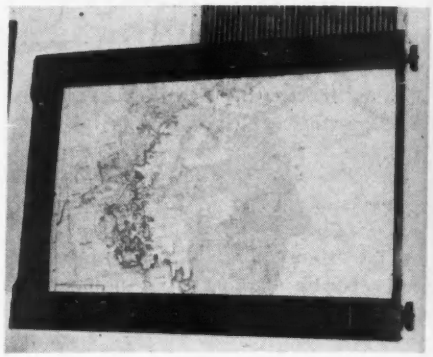
PRODUCTION HINTS

HOW TO— Make Handy Map Holder

Large field maps required in the office of production engineers and superintendents become unwieldy, frayed at the edges, and eventually torn unless a satisfactory method of handling them is provided. A convenient map holder that enables its user to mount the map on the wall of his office without utilizing a large space, also makes the entire length of the map easily accessible.



Length of the map itself is several times the length of the exposed section in the holder frame shown. The remainder of the map is rolled up on spindles at top and bottom of the frame. Size of the holder can be made to fit the dimensions of the field map to be mounted. The map shown is approximately three feet wide, and the entire frame is made of one-inch lumber. The holder is four inches deep and about 28 inches high. The spindles extend the full length of the holder and are pivoted at either end. They extend through the side piece on the right and three-inch diameter wooden wheels mounted on the ends.

By rotating the top or lower spindle, the map can be wound in either direction to the desired portion of the field map. This holder is at a convenient height for use and is out of the way. The map is preserved and large size maps can be accommodated by such easily-constructed holders.

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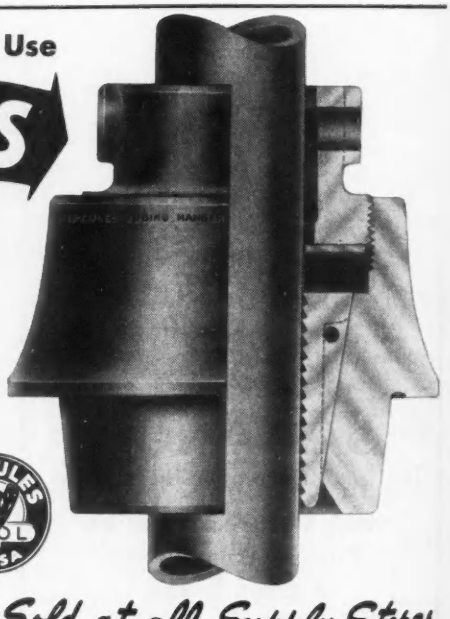

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Flow Conditions In Large Diameter Crude Lines

THE AUTHOR describes tests on large-diameter lines to determine the relationship between friction factor and Reynolds number under actual operating conditions and then derives or simplifies existing equations for capacity curves and other design data.

By **LOWELL E. ANDERSON,** Service Pipe Line Company

ONLY within the past few years have large-diameter lines been widely used for the transportation of crude oil. Until recently, the largest diameter line commonly used was 12 inches. As used in this discussion, "large diameter" will refer to lines 16 inches and larger. In the crude oil transportation field, lines of this size and larger come under the classification of "big-inch" lines.

Paralleling the laying of larger lines has been the increased stress placed on designing these lines on a technical basis. A rule of thumb was used in the design of many systems in the past and certain standards were closely adhered to such as the 40-mile spacing between stations. At the present time, however, the effect of a number of factors can be more accurately evaluated than in the early days of pipelining. Examples of this are the strength of the steel used in making the pipe, the method of forming the steel into the pipe, and the method of joining pipe sections. The higher tensile strength steel of today permits higher operating pressures and present-day manufacturing methods permit designing a line with varying wall thicknesses.

In these larger lines the throughput is much greater so the need exists for an accurate knowledge of the relationship between throughput and the corresponding force required. This is of great importance so that the optimum size line and station spacing can be ascertained for new systems and the length of loops required for additions to present facilities can be accurately determined. When designing a new system, a basic design capacity is of course first established. A great many factors enter into the establishment of this design capacity, which can be very briefly summarized as supply of crude available at the origin and demand at distribution points along the line. Establishing this design capacity so that actual volumes approach it is of course a prodigious task because of the great many variables involved. Because of the great costs involved in building a pipe line system, it is extremely important that actual operating conditions be estimated as closely as possible. If the pressure required to gain the desired throughput can be accurately determined, the entire system can then be designed to fit these conditions. This will eliminate "over-design," such as providing pipe of greater wall thickness than necessary and installing pumping equipment to withstand higher pressures than actually will be encountered. A thorough knowledge of flow characteristics will also eliminate the possibility of "under-design," i.e., constructing a system that fails to provide the capacity it was designed to furnish.

D'Arcy in 1857 propounded a formula for flow of fluids in closed conduits which has been found to be the most applicable of the various flow formulas for hydraulic calculations involving crude. The D'Arcy equation combines an empirical term and a number of physical factors that are characteristic of the particular problem under consideration. This equation in its basic form is expressed as $h_f = \frac{flv^2}{2gd}$, which states that the friction head is proportional to the length of the line, l; the square of the fluid velocity, v; the empirical dimensionless friction factor, f; and is inversely proportional to the diameter. In the above form, the equation is solvable if the various quantities are expressed in foot-pound-second units, giving the value of h_f in feet. This is not a convenient form, however, since foot-pound-second units are not commonly used in pipe line terminology. Converting this equation to a more practical form, it becomes

$$P = \frac{34.87\, f\, B^2\, s}{D^5} \qquad (1)$$

where:

P = pressure drop, psi per mile

f = dimensionless friction factor

B = line throughput, barrels per hour

s = specific gravity of oil being pumped

D = internal diameter of line, inches

All quantities can be physically measured with the exception of the friction factor which must be determined by experimentation.

Since the only unknown in the equation is f, it is of prime importance that this factor be assigned values as exact as possible. The usual manner of expressing f is to plot its value against the corresponding value of Reynolds number, R, which is in existence in the line at that particular time. In addition to providing a basis for expressing f, the Reynolds number is used for determining whether the flow conditions result in streamline flow or turbulent flow, the common point of demarcation separating the two types being a Reynolds number of 2000. In its basic form, R is determined by use of the equation

$$R = \frac{dv\rho}{\mu} \qquad (2)$$

where:

d = diameter of pipe

v = velocity of fluid

ρ = density of fluid

μ = absolute viscosity of fluid

Any consistent set of units can be used in this equation so that R results in an abstract number.

Here also, a more convenient form can be derived so that the value of R can be determined by using everyday pipe line terms:

$$R = \frac{2214 \times B}{D \times \nu} \qquad (3)$$

where B and D have the same significance as stated previously, and ν is the kinematic viscosity, in centistokes, of the oil moving through the line. To simplify the use of this equation, a relationship has been established between centistokes and Saybolt Universal Seconds (SUS). Tables published by the American Society of Testing Materials give the corresponding value of SUS with respect to the basic centistokes values. An equation which gives an approximate relationship has been formulated, stated as

$$\text{centistokes} = 0.22t - \frac{180}{t} \qquad (4)$$

where t represents Saybolt Universal Seconds.

For streamline flow conditions, a basic relationship has been analytically derived and verified by the work of many experimenters. This relationship has been shown to be valid for all streamline flow conditions so will hold true for large-diameter lines moving crude oil. It is stated as $f = \frac{64}{R}$ which, when substituted in equation (1) gives:

$$P = \frac{1.008\, B\, \nu\, s}{D^4} \qquad (5)$$

This can be further simplified and the number of terms reduced by expressing the product of the two terms ν and s as the absolute viscosity μ, which is in centipoises. For practical purposes the coefficient 1.008 can be assumed to be unity so that the resultant form is

$$P = \frac{B\mu}{D^4} \qquad (6)$$

For turbulent flow, however, no such simple direct relationship can be derived to express the value of the friction factor. A great amount of research has been carried out on the value of the friction factor and a wide variation in results has been obtained, depending on the type of conduit tested and the other factors that established the flow conditions used in the test work.

This discussion will describe a number of tests run recently to evaluate the friction factor in large-diameter lines moving crude oil and to express and use the results obtained from these tests.

The purpose in conducting the tests on large-diameter crude lines was to ascertain which data, if any, obtained by laboratory experimentation would be confirmed by our data. Various authors concur with the reasoning that their results obtained from smaller lines may not hold true for larger lines.

To get information such as was desired, sections of large-diameter lines in a trunk pipe line system were utilized as test sections, thus providing the best large-scale laboratory possible. Since pilot studies used in research work can never completely and exactly duplicate conditions found in the full-size project, it was desired to obtain data from present facilities for use in future design work.

The friction factor was determined in each of a series of tests run on a number of sections of line. As stated previously, f must be determined experimentally since it is an abstract term. This was done by using equation (1), measuring the 4 quantities P, s, B, and D, and solving for the unknown quantity f. In conducting the tests, the pressure drop P was measured by placing a recording pressure gauge at each end of the test section of line and calibrating it in place by means of a dead-weight tester. The pressure drop was then determined by taking the average difference in readings between the two pressure gauges, correcting this for the effect

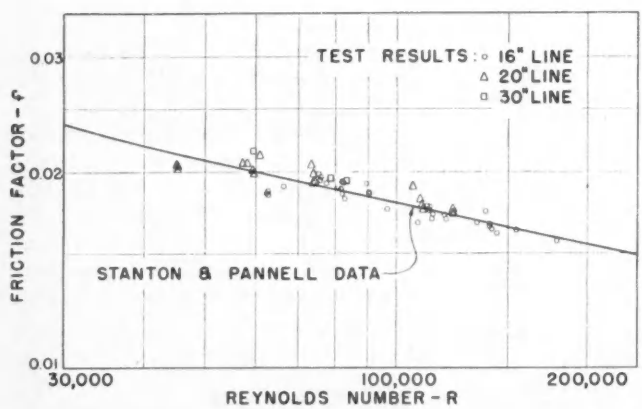

FIGURE 1. Plot of experimental points determined from crude oil lines in actual operation, as compared to data of Stanton and Pannell. Graph covers Reynolds numbers ranging from 45,000 to 180,000, to obtain friction factor values.

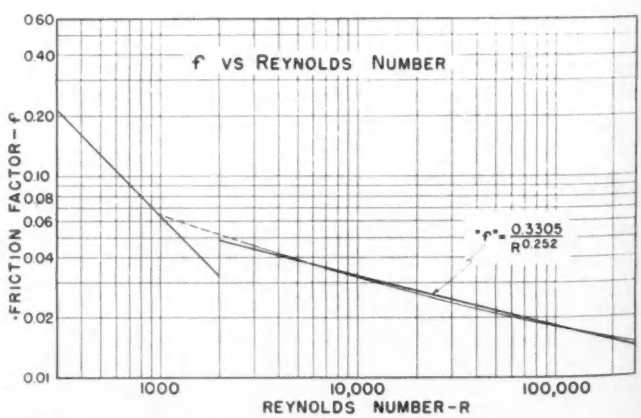

FIGURE 2. Straight line relationship between friction factor and Reynolds number of turbulent flow, based on Stanton and Pannell curve. This relationship derived for the range of Reynolds numbers normally encountered in crude oil lines.

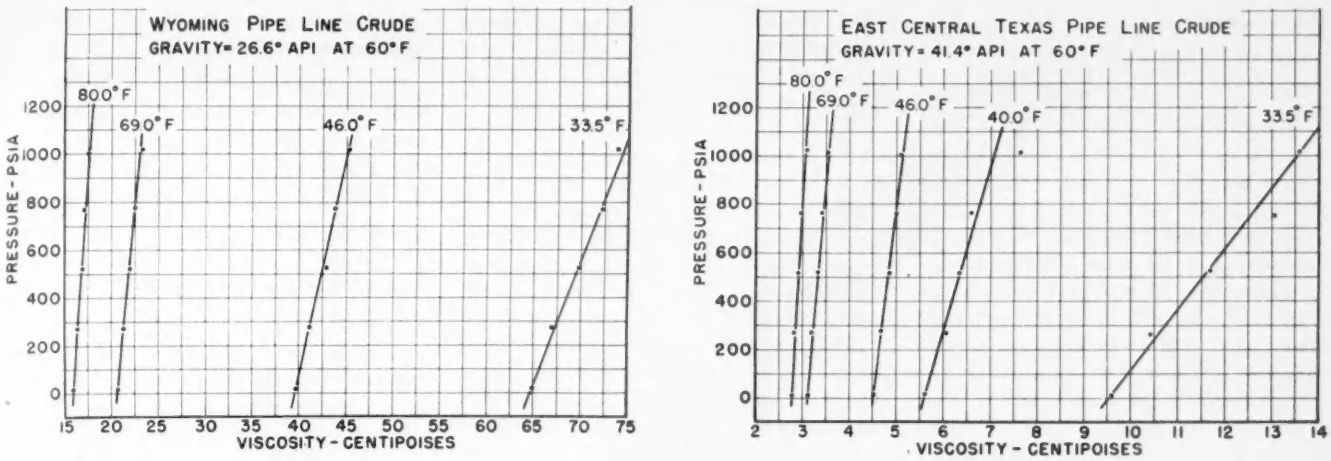

FIGURE 3. Effect of pressure on viscosity of two crude oils in the range of pressure and temperature normally encountered in actual operation.

of the difference in elevation between the two points, and dividing this net difference by the number of miles between the by the number of miles between the two gauges. In determining s, the specific gravity, samples were taken from the line at frequent intervals as the stream passed the origin point, and gravity determined by means of hydrometers. Averaging these readings then gave a representative gravity of the oil in the entire test section of line. The gravities in the lines tested varied from 32° to 44° API, but for any single test remained essentially constant. For determining the amount of oil pumped, B, operations were arranged so it was possible to pump out of one tank so the volume moved through the line could be measured by periodic tank gauges. The value for the internal diameter was taken as the nominal internal diameter with no allowance being made for manufacturing tolerances. This value is sufficiently accurate since the nominal internal diameter is used in all calculations. To insure that the effect of the complete internal diameter was being measured, a pig-type scraper was sent through the line just prior to the running of a test. This removed any wall deposits which, if left on the walls, would reduce the internal diameter, which in turn would result in a higher apparent friction factor.

The above data were necessary to calculate f but do not give any basis for expressing the relationship between f and R. Referring to equation (3), it is seen that to compute R, the kinematic viscosity of the oil being pumped is needed. This was obtained by measuring the viscosity of the periodic samples.

In Figure 1, the section of the Stanton and Pannell curve between Reynolds numbers of 30,000 and 240,000 has been reproduced. Plotted on this graph are the experimental points determined from the author's tests which covered the range of Reynolds numbers from 45,000 to 180,000. These values for f, plotted against R, were obtained on sections of lines of 16-, 20-, and 30-inch nominal diameter.

The values from the 16-inch lines fall about evenly above and below the Stanton and Pannell curve. Two sections of this size line were tested: one section in West Texas was 40 miles long, and had been in service about 5 years, moving sour West Texas crude; the other section consisted of 15 miles in Oklahoma and had been in service about 3 years moving Mid-Continent sweet and sour crudes.

Results from the 20-inch lines fall somewhat higher on the curve than the points from the 16-inch tests. Two sections of 20-inch line were also analyzed. The longer section tested was between 2 stations in Missouri, a distance of 74 miles, while the other section consisted of approximately 57 miles of 20-inch pipe in Oklahoma. Each of these lines had been in Mid-Continent sour and sweet crude service for a period of about 2 years.

Values obtained from tests on the 30-inch line fall even higher above the f versus R curve. The line used for these tests was a tank line approximately ½-mile in length, and with ¼-inch wall thickness. Because of the short length of this line, it was necessary to measure the pressure drop by installing a mercury manometer at each end of the line, and correcting the difference in readings for the effect of elevation difference. It is believed the friction factor for trunk lines of this diameter would be somewhat lower than shown here for two reasons. First, the 30-inch tank line was laid above ground and because of its high $\frac{D}{t}$ (diameter to wall thickness) ratio, it probably was not perfectly round. Secondly, the section tested included an expansion joint which would increase the pressure drop and give a higher apparent friction factor.

W. G. Heltzel[1] did a great amount of work on the friction factor encountered in crude lines varying in diameter from 6 to 12 inches, the latter being the largest size crude line in service at the time his work was carried out. His results indicated that the Stanton and Pannell curve represented very closely the friction factor encountered in these sizes of line. The results presented here, coupled with the work of Heltzel, appear to be sufficient confirmation of the Stanton and Pannell curve to warrant using it for crude-oil lines in the range of diameters from 6 inches to 30 inches. The author's data do not cover the entire range of Reynolds numbers encountered in the sizes of lines tested but do include the majority of normal flow conditions.

Having established the validity of the Stanton and Pannell curve for crude lines, an expedient equation will be developed for determining directly trunk-line capacity, other factors being known. The use of equation (1) for determining pressure drop is relatively simple but the use of this equation for determining capacity is much more laborious since a cut-and-try process is involved.

To begin with, a mathematical relationship between f and R must be established. Referring to the Stanton and Pannell curve, it is seen that this curve is very nearly a straight line when plotted in double logarithmic form. Therefore, by drawing a straight line through points on the friction factor curve corresponding to Reynolds numbers of 6000 and 130,000, a line approximating the curve will result, as shown in Figure 2. A straight line on double logarithmic paper has the characteristic form:

$$X = \frac{K}{Y^a} \qquad (7)$$

The straight line as drawn above can

thus be expressed as

$$f = \frac{0.3305}{R^{0.262}} \qquad (8)$$

by substituting known values in equation (7).

This line does not vary widely from the curve, and deviates less than much of the test data. The range of Reynolds numbers from 6000 to 130,000 includes the majority of flow conditions encountered in crude lines. The highest value encountered in the system used for the tests was 200,000, with the greater percentage of flow conditions giving Reynolds numbers below 100,000. Using a straight line above the curve will give a higher pressure drop than a smooth pipe line would give. This resultant higher pressure will compensate for certain factors which are not evaluated for individual lines such as:

1. Decrease in effective internal diameter between the running of scrapers.
2. Additional roughness caused by internal corrosion. This factor is normally of minor importance since pressure and velocity keep water, the main cause of internal corrosion, from settling out.

Referring to equation (8) and substituting $R = \frac{2214 \times B}{D \times p}$, we obtain

$$f = \frac{0.0474\, D^{0.262}\, p^{0.262}}{B^{0.262}} \qquad (9)$$

This in turn is substituted in equation (1) resulting in

$$P = \frac{1.653\, B^{1.748}\, p^{0.262}\, s}{D^{4.748}} \qquad (10)$$

Solving this for B, we obtain

$$B = \frac{0.750\, P^{0.572}\, D^{2.716}}{p^{0.344}\, s^{0.572}} \qquad (11)$$

This equation is somewhat cumbersome to use but in any one line the factors of viscosity and gravity are usually constant so these factors and the $D^{2.716}$ factor can be combined into a constant, leaving the equation as

$$B = \text{constant} \times P^{0.572} \qquad (12)$$

Equation (11) is useful in drawing up capacity curves on double logarithmic paper, or when used as the basis for a slide rule, both of which provide convenient means for solving flow problems.

In conjunction with the tests for determining the friction factor, an investigation was made into the effect of pressure on viscosity. Temperature of course has a great effect on viscosity but the effect of pressure is less well known. It was known that viscosity tests run at atmospheric pressure did not give a true picture of the viscosity of the oil moving through the line under pressure. Viscosity increases with pressure, but it was not known the amount it increased for crude oil in the pressure range in which pipe lines normally operate. Since in recent years higher operating pressures are being used, the importance of the effect of pressure on viscosity is rising parallel to the rise in pressure.

As an indication of the effect of pressure, 2 samples of crude oil were analyzed to determine the extent their viscosity varied with pressure at different temperatures. Figure 3 shows the results obtained by means of a falling-ball type of viscosimeter. The two samples tested represent the extremes of the common stream crudes handled in most pipe lines since the East Central Texas crude is one of the lightest and the Wyoming is one of the heaviest common stream crudes. The results obtained indicate that at any certain temperature the viscosity-pressure relationship is a straight-line function. In the higher temperature range, the effect of pressure is about the same for the 2 crude oils, but at lower temperatures the viscosity of the lighter crude increases a larger percentage. For either crude, the effect of temperature is much greater at lower temperatures. Based on this trend, the supposition is made that if the temperature is increased sufficiently, pressure may cease to have a measurable effect on viscosity in the region of pressure here considered.

These test results indicate that the effect of pressure on viscosity is a factor of definite importance and shows that the commercial viscosimeters normally used do not give a true picture of the viscosity of the oil as it moves through the line. It is readily seen that using a correction factor in flow calculations for converting the viscosity at atmospheric pressure to the true viscosity at a certain temperature and pressure would indeed be laborious. Therefore, in the test work carried out, the viscosity at atmospheric pressure was used in determining the Reynolds number. Using this viscosity instead of the actual viscosity of the oil under pressure gives an apparent relationship between f and R since the Reynolds number computed is not the true value. This apparent R contains the factor of viscosity change due to pressure. Under streamline flow conditions, the viscosity is of greater importance since, as seen from equation (5), the pressure drop varies directly as the viscosity. It will be necessary therefore to use an average correction factor based on the average pressure in the section of line being considered. No actual operating data under streamline flow conditions have been obtained since this type of flow is not frequently encountered.

Some crude oils are thixotropic, which is a characteristic that tends to counteract the effect of pressure on viscosity. Thixotropic crudes are those whose apparent viscosity at any certain temperature decreases as the shear rate increases. Thixotropic crudes have been found in certain sections of the Wyoming-Utah area, and are characterized by a high pour point, some of them remaining congealed at temperatures as high as 70° F. Because shear rate increases in a particular line as the pumping rate increases, the apparent viscosity will vary inversely as the pumping rate. Since the pumping rate determines the pressure, a relationship exists between pressure and the thixotropic characteristic. For this type of crude, the viscosity should be determined by a viscosimeter which simulates line conditions. An efflux-type viscosimeter cannot be used for this crude oil at lower temperatures since the oil will congeal in the tube and no reading can be obtained. The writer does not know of a viscosimeter that provides for the measurement of viscosity under pressure at varying shear rates. A temperature-viscosity curve can be drawn up for a particular crude based on a study of operating data, this then giving an apparent viscosity at different temperatures which can be used in flow calculations.

The crude oils of a thixotropic nature are of a minor percentage however, since most crude oils are classified as Newtonian, i.e., their viscosity is independent of the shear rate.

About the Author

LOWELL E. ANDERSON, a native of Nebraska, attended the University of Omaha and the University of Nebraska and obtained a B. Sc. degree in civil engineering from the latter in 1946. He was employed by Phillips Petroleum Company after graduation and worked in the Supply and Transportation department. In September, 1947, he joined Service Pipe Line Company (formerly Stanolind Pipe Line Company) and since that time has been in the hydraulics section of the Engineering department.

REFERENCE

[1]Heltzel, W. G. "Fluid Flow and Friction in Pipe Lines." Oil & Gas Jl., Vol. 29, June 5, 1950.

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MAGNETIC SCRAPER LOCATOR

By JACK WEIR JONES
Sun Physical Research and Development Laboratory
Newton Square, Penn.

TRACKING THE progress of a pipe line scraper, and its location if stuck, are necessary chores in trunkline operation, and have been the subject of much research and experimentation. Here the author describes construction and operation of a magnetic locator which depends upon magnetism impressed onto the scraper itself. Despite steel walls, sufficient magnetism penetrates the pipe to be indicated on the control unit.

FIGURE 1. Operator carries detector, being careful to align it with buried pipe line. Batteries and control box are suspended by shoulder straps for even distribution of weight.

THE problems associated with running scrapers through pipe lines are well known. The progress of the scraper through the line is followed so that in the event it becomes stuck, its approximate location will be known. A stuck scraper can seriously reduce the line capacity and in an extreme case may even entirely block the line. In either case, the scraper must be located and removed at the earliest possible moment.

Several methods have been used to follow scrapers. The usual one is to listen for the noises made by the scraper in its passage. Occasionally these noises are not sufficiently strong to be audible at the surface. If the scraper is stuck, liquid bypassing it is usually quite audible, but this method fails, of course, whenever the line becomes plugged. Another method which has been mentioned recently consists of mounting a radioactive material on the scraper and detecting the accompanying radiation with a Geiger-Muller counter. This method has possible disadvantages in the short range of detection through solid earth and in difficulties encountered in observing precautions which must be taken to protect personnel while handling strongly radioactive materials.

A new approach to this problem has been made at the Sun Physical Research and Development Laboratory. In this method, the scraper is magnetized and is located by a portable and very sensitive magnetic detector.

When this idea was first suggested it was given little hope of success, because it was at first thought that the welded line would provide a magnetic "shield" which would reduce the field of the magnetized scraper to a level too small for practical results. A theoretical analysis was made, however, which indicated that although the field would be considerably reduced, the shielding effect of the pipe would not be complete. Accordingly, equipment was constructed and direct measurements made. These measurements confirmed the analysis and demonstrated, for example, that the field is reduced by only 80 percent at a distance of ten feet from an 8-inch line. The residual field is sufficiently strong to be detected easily by a sensitive magnetic detector.

Several of these locators have been constructed and have been used in pipe line operations by the Susquehanna Pipe Line Company for the past two years. Figure 1 shows an operator using the first model constructed. Figure 2 shows the most recently constructed equipment which incorporates several improvements.

The principal elements are (1) the detector, consisting of an aluminum tube two inches in diameter and three feet long, which houses the magnetically sensitive elements, (2) the "control" box which houses the electronic circuit and indicating meter, (3) the battery box which houses dry-cell type batteries for power, and (4) earphones for audible detection. Another model has been constructed in which the control box and the battery box were combined in a single housing. The total weight of the equipment, including batteries, is 27 pounds where extreme portability is

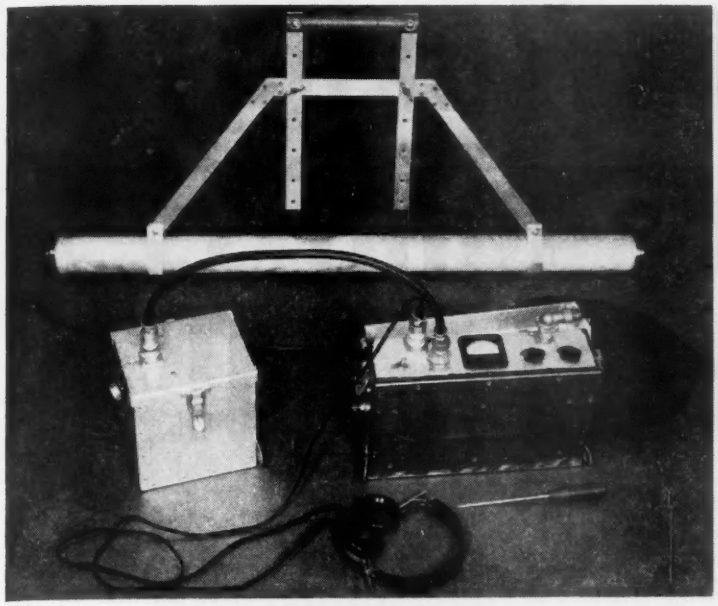

FIGURE 2 (left). Type of detector with aluminum housing for elements, and separate battery box and control unit having earphone attachment for audible evidence of passing of scraper.

FIGURE 3 (right). Equipment for magnetizing scraper. It is slipped within the housing and direct current, as from welding generator, passed through coils for short time. With hardened shaft, scraper retains high degree of magnetism.

desired and shorter-lived, lighter batteries are used. Heavy duty batteries add 20 pounds.

The detector houses two sensitive elements located near the ends of the aluminum tube. Outputs from these elements are connected so as to oppose each other and thus there is no response to a uniform magnetic field such as the earth's field. Any ferromagnetic object will cause a local distortion in the earth's field. That is, the magnetic field intensity will not be the same at each of the sensitive elements. The output of one of the sensitive elements will be larger than the output of the other, and a signal results which may be observed on an electric meter or heard in earphones.

Figure 3 is a photograph of the magnetizer constructed by the Susquehanna Pipe Line Company to magnetize scrapers for their 8-inch and smaller lines. A cross-section of the magnetizer is shown in Figure 4. The dimensions are not critical and fabrication is relatively simple. The scraper is inserted in the magnetizer and magnetized by passing about 300 amperes through the coil for a few seconds. Current provided by one of the gasoline-driven welding generators used in normal pipe line welding operations is a convenient means to excite the magnetizer.

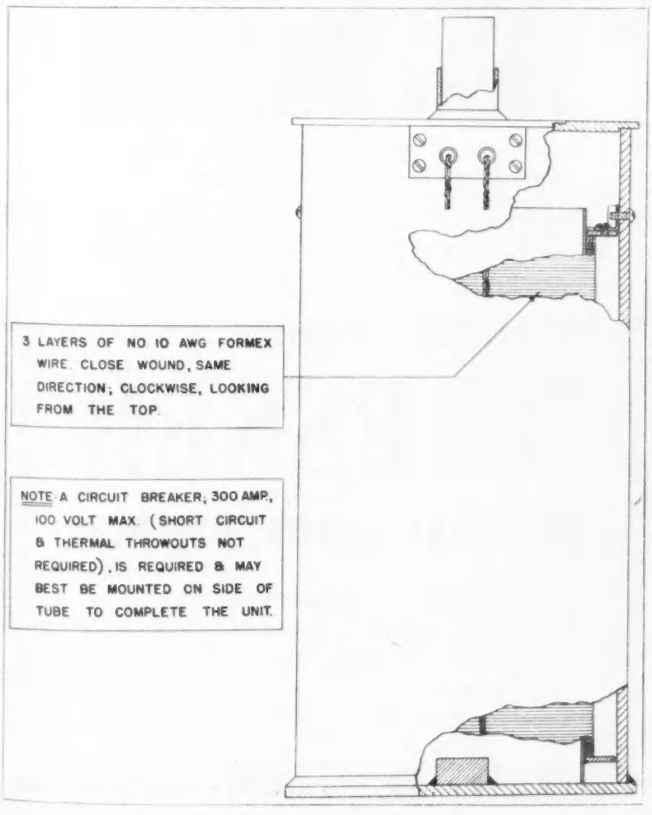
3 LAYERS OF NO. 10 AWG FORMEX WIRE. CLOSE WOUND, SAME DIRECTION; CLOCKWISE, LOOKING FROM THE TOP.
NOTE: A CIRCUIT BREAKER, 300 AMP, 100 VOLT MAX. (SHORT CIRCUIT & THERMAL THROWOUTS NOT REQUIRED), IS REQUIRED & MAY BEST BE MOUNTED ON SIDE OF TUBE TO COMPLETE THE UNIT.

FIGURE 4. Diagrammatic sketch of magnetizer construction, giving wire size and current requirements for energizing scraper. This type, designed for vertical placement, carries current leads through eyelets which permit removal of upper head for inserting scraper.

The major use of the scraper locator lies in following scraper progress by detecting passage at road intersections. In this case the equipment is placed in an automobile and the detector, which is provided with 25 feet of cable, is placed on the ground near the line and off to one side of the road. The equipment can be operated in the vehicle, but the passage of an automobile at the same time that the scraper arrives could obscure the scraper signal. Placing the detector 25 feet away reduces the effect from passing automobiles to the point where there is no danger of missing the scraper signal. When used in this way the range of detection is considerable. Where the scraper shaft is made of ordinary soft steel the passage of the scraper may be observed at a range of about eight to ten feet from the pipe line, with a signal which is one-half of full scale deflection on the meter. A scraper having a shaft made of hardened steel is a more effective magnet. These scrapers may be detected at a distance of 20 feet. Signals of this intensity are easily heard in the earphones. When no signal is present, a slight audible

■ CONTINUED ON PAGE 208

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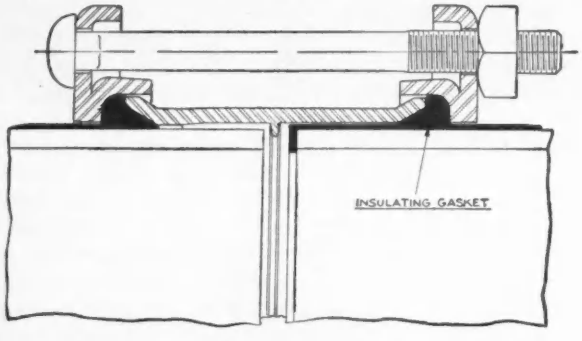

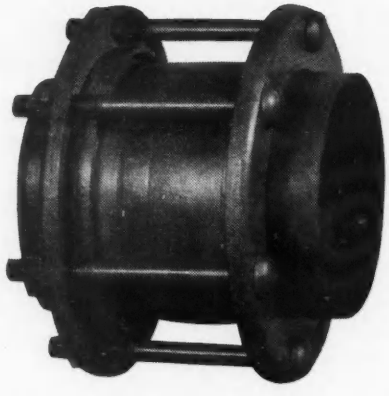

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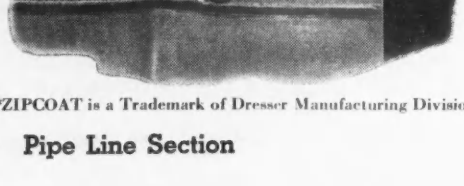

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Heating and Distribution System for Station Fuel Gas

USE OF engine jacket water through heat exchangers enables one pipe line station to overcome the hydrate problem, and to dispense with local heating units downstream from the various stepdown regulators required to convert fuel from trunk-line to use point pressures.

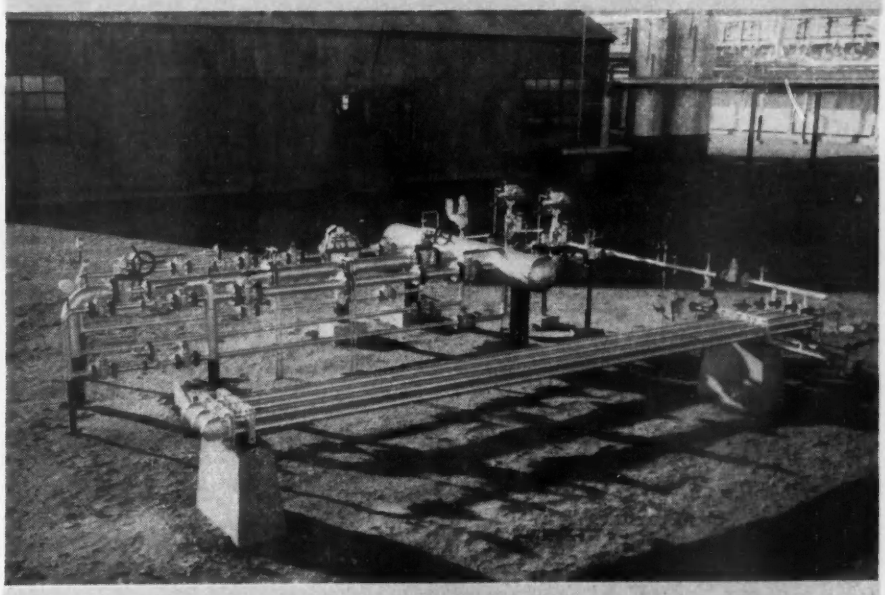


FIGURE 1. In this centralized installation, fuel gas at 500 pounds per square inch is heated by jacket water heat exchangers (in foreground), reduced in pressure, and distributed to three different plant services.

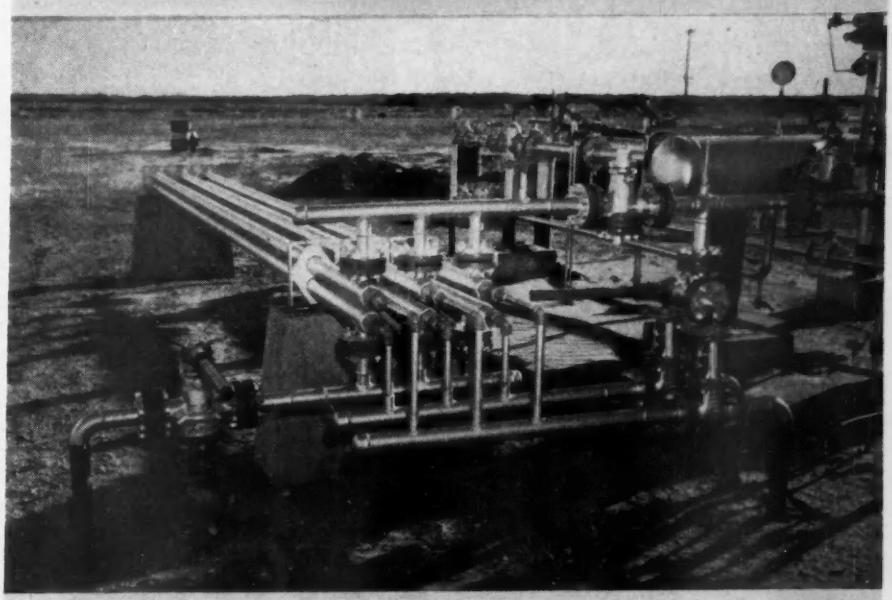
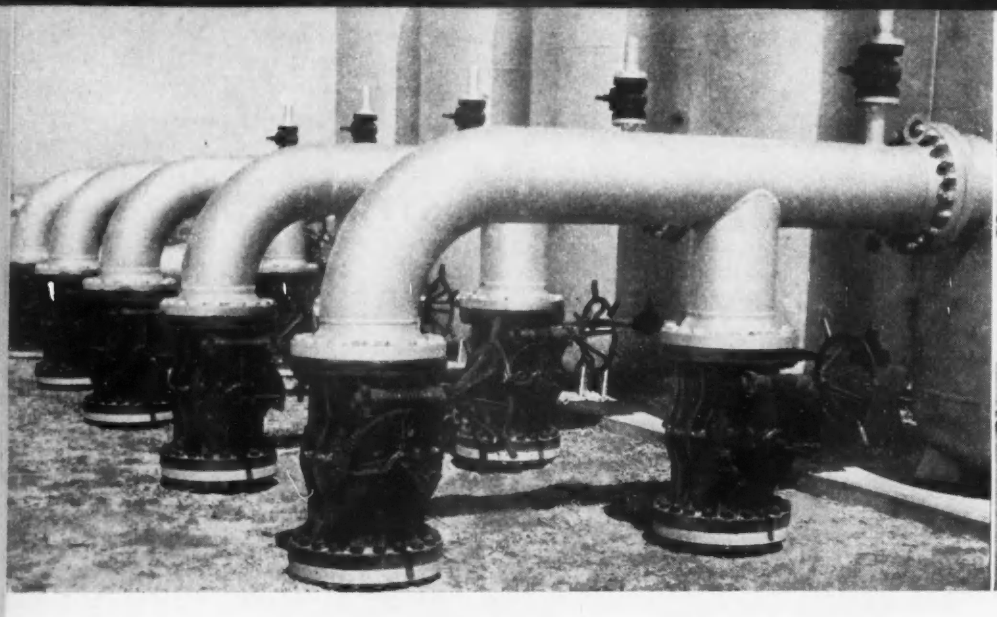


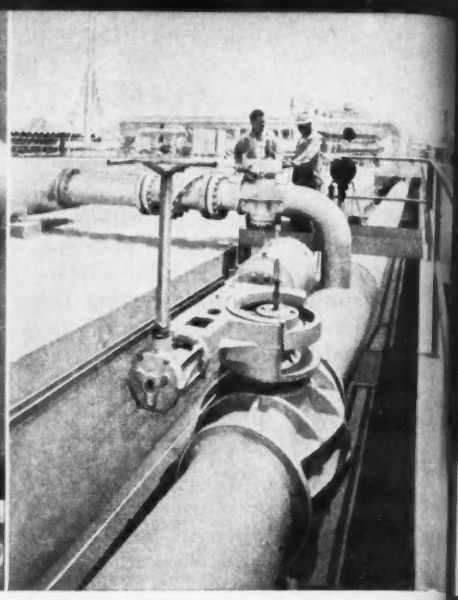
FIGURE 2. Close-up view showing details of heat exchanger manifolding. Incoming and outgoing jacket water lines are in foreground. High pressure gas enters through two-inch line at left, moves into annulus of heat exchangers and emerges at top, to continue on to main header at extreme right.

EFFICIENCY, compactness and accessibility are combined in the heat exchanger installation illustrated. In this one group, centrally located on the grounds of a large West Texas main line natural gas pumping station, incoming fuel gas at high pressure is heated in a small heat exchanger utilizing engine jacket water, reduced in pressure, and delivered to an adjacent distribution manifold where pressures are further reduced and the gas delivered to three different plant services. These services are (1) the main compressor engines; (2) the auxiliary power plant engines; and (3) domestic gas used in the office and homes of employes living on the station.

Incoming gas from the main transmission line enters the manifold at a pressure of 500 pounds per square inch. In the reduction of this gas to the lower pressures required for the several services, there generally existed a constant threat of regulators and fittings freezing up. This danger increased during the colder winter months and even during other parts of the year when night-time temperatures would drop rather sharply. This problem is common to numerous pumping stations, and various methods have been developed by as many operators for prevention of freezing of fuel gas lines where fuel is taken from a high pressure transmission line.

The present installation is located strategically beside the main compressor house and is centrally located to all the principal activities of the station. All segments of the installation (Figure 1) are neatly mounted on concrete footings and are spaced far





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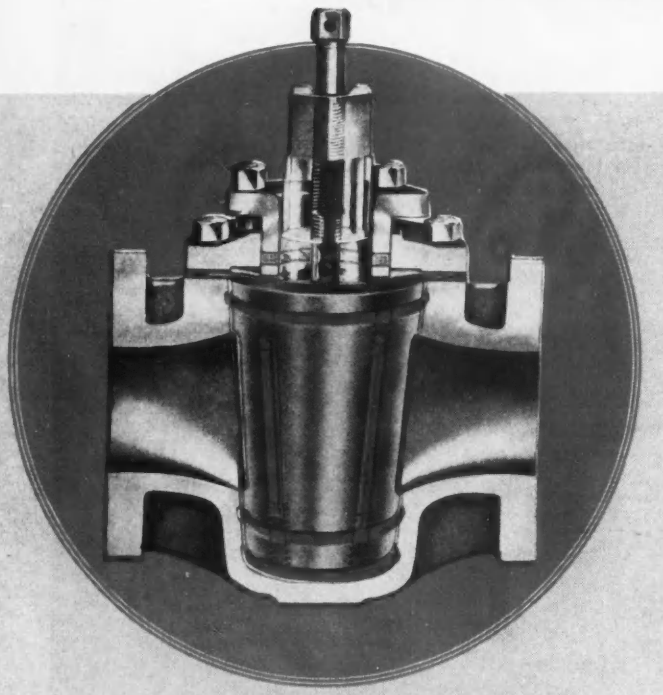

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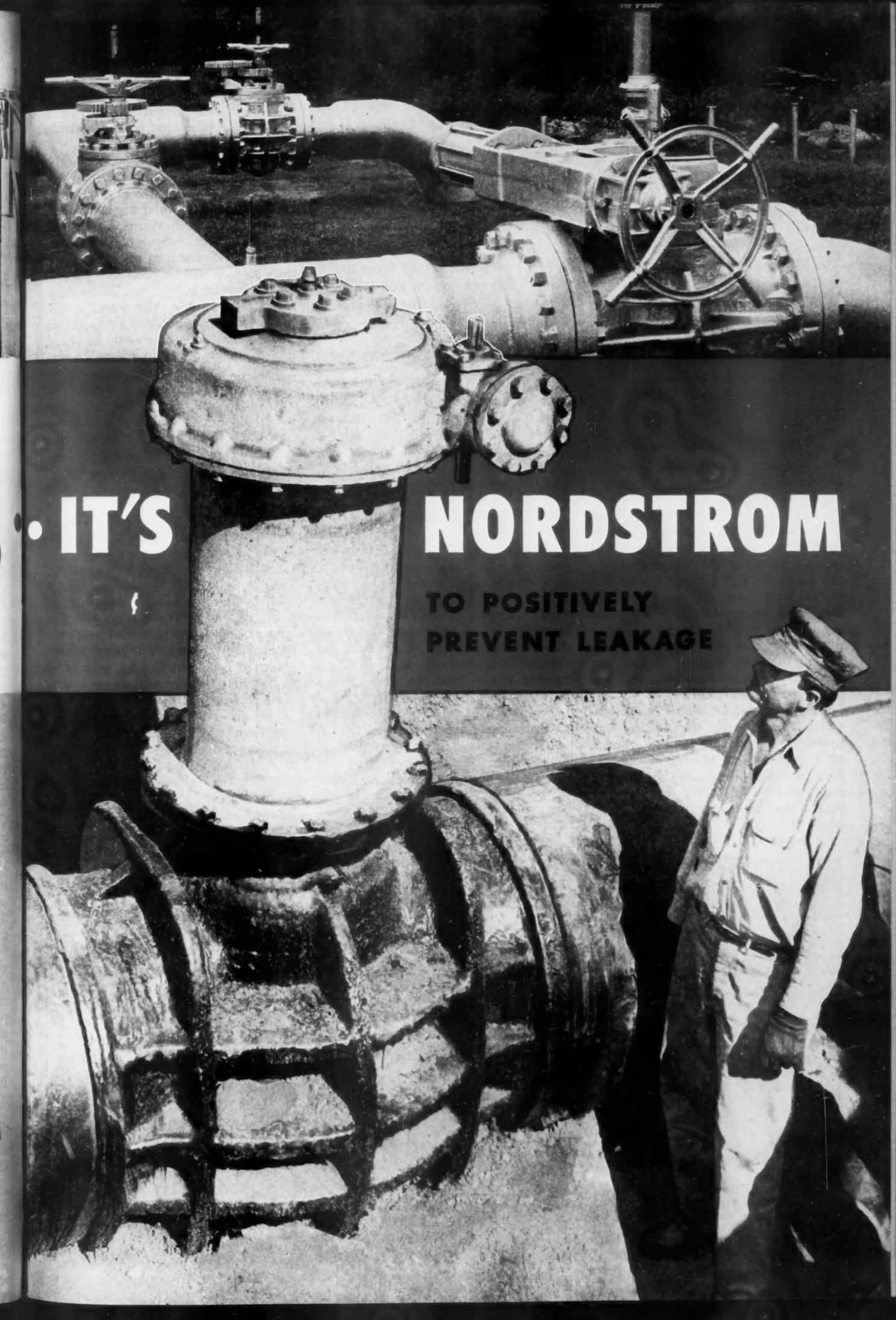
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enough apart and sufficiently high above the ground so that a man easily can service or repair any part of the equipment.

The three heat exchangers are of the hairpin or U-bend type and are 20 feet long. The outer shell and inner tube are of 2½- and ¾-inch pipe, respectively. Engine jacket water coming from the main compressor engines enters the exchanger through the inner tube, traverses the entire length, and returns to the header where it then enters the line returning to the plant. Heat is imparted to the high pressure gas which is circulated through the annulus between the outer shell and the water tube. In normal operation, jacket water enters the exchanger at a temperature of about 145° F and emerges at plus or minus 135 degrees.

Compact Header Arrangement

A close-up view of the header assembly, showing incoming and outgoing water and gas lines, is shown in Figure 2. The 2-inch water line header is in the immediate foreground. High-pressure gas in the 2-inch line coming in from the left enters the exchanger through a flange connection in the under side of the exchanger shell, and emerges through a similar connection in the upper run. The three lines then are manifolded into a common line leading to the first pressure reducing regulator and the main distribution header.

At this regulator the heated gas, still at 500 pounds per square inch pressure, is reduced to 120 pounds per square inch. After entering the 16-inch by 12-foot main header, the gas is distributed to the three service lines, these being (1) a 6-inch main plant engine fuel line; (2) a 4-inch (later reduced to 2-inch) line to the auxiliary power engines; and (3) a 2-inch domestic line. Each of these distribution lines extends horizontally, four feet above the ground, for a distance of approximately 15 feet, providing ample space for the installation of control valves, flanges, regulators, and in the case of the domestic line, a meter.

The 120-pound gas delivered to the main compressor plant engines later is reduced to 40 pounds after it enters the plant. Gas entering the auxiliary power plant line is reduced first to 20, then to three pounds per square inch. Domestic gas is metered, reduced to 20 pounds per square inch, then later reduced at the various houses.

Each of the distribution runs is equipped with a parallel bypass line which takes off from the under side of the cylindrical main header, and which is mounted about midway between the main run and the ground.

Exceptionally good results have been obtained with this fuel gas heating and regulating system. The unit has operated efficiently and continuously even through the most severe cold weather periods experienced in the area. A similar installation, placed in operation in another plant owned by the same company in West Texas, has operated continuously and without trouble of any kind for more than a year.

Simplicity of design and efficient utilization of otherwise wasted jacket water heat have been combined to make this an unusually neat, practical and relatively inexpensive installation for the trouble-free distribution of fuel gas.

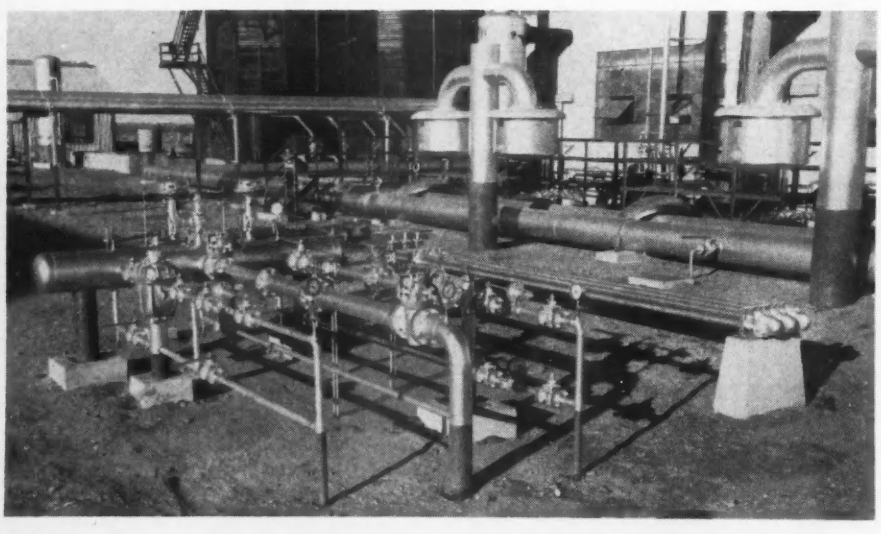

FIGURE 3. This is the layout of the three distribution lines connecting into the 16-inch by 12-foot main header. From left to right the lines are (1) domestic line; (2) fuel line to main compressor plant engines; and (3) fuel line to auxiliary power plant engines.

Magnetic Scraper Locator

■ CONTINUED FROM PAGE 203

tone is heard. When the scraper passes, this tone changes in loudness and in quality.

If the scraper becomes stuck, the detector is carried along the pipe line right-of-way as shown in Figure 1, with the detector tube aligned parallel to the pipe line. When used in this way a certain amount of experience is required on the part of the operator since signals will be produced by surface magnetic litter, such as tin cans, and also by rotating the detector with respect to the pipe line. Signals from surface materials are local, however, and an operator soon learns to distinguish them from the scraper. He also can easily learn to recognize the effect of rotating the detector. Because of the presence of this interference, the range is somewhat reduced, but an operator with experience can find scrapers with soft steel shafts at ranges of five to eight feet from the line. Since the signal from the scraper exists for a distance of several yards, local objects are easily identified and disregarded.

The detector tube is completely waterproof and may be operated under water (as may be necessary in river crossings). The control box and battery box are splashproof and may be operated in rain. The batteries are standard types stocked by most radio stores; they require replacement after approximately 40 hours of continuous operation. Radio tubes used in the electronic circuit are also standard and are good for several hundred or even thousands of hours of operation. The detector is ruggedly constructed and is able to withstand severe shock. Normal maintenance consists of periodic replacement of batteries.

ACKNOWLEDGMENT

The subject matter of this paper is included in the disclosure and claims of a pending patent application assigned to Sun Oil Company.

About the Author

JACK WEIR JONES received a Bachelor of Science degree in physics from Western Kentucky Teachers College in 1939 and a Master of Science degree in physics from the University of Kentucky in 1941. Immediately after graduation he joined the Naval Ordnance Laboratory in Washington, D. C. In January, 1946, he joined the staff of the Sun Physical Research and Development Laboratory of the Sun Oil Company at Newtown Square, Penn.

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Maintenance and Operation of

Plug Valves

By ROY R. BUSH

Rockwell Manufacturing Company, Tulsa

TYPES OF plug valves for pressures and temperatures met in pipe line service are described by the author, who lists points to be watched when servicing or overhauling plug valves. Although applying directly to the design of valves illustrated, the pointers can aid in improving service of plug valves of all makes and designs.

A PLUG valve is a very simple piece of mechanical equipment, consisting mainly of the plug and body; therefore, its maintenance should also be a simple matter. However, like all types of good mechanical equipment, a certain amount of attention and thought must be given to its proper operation. A large part of operation and maintenance troubles with plug valves is due in many instances to an improper original installation. On each job, careful thought should be given to the proper valve, and by all means, the proper lubricant for the various fluids or vapors to be handled.

In general, plug valves are manufactured in different types which, for purposes of this discussion, are designated "Standard," "Intermediate" and "High Pressure."

Standard Valve

In the standard type valve the packing gland and body cover are of one-piece construction. This valve will perform satisfactorily at pressures up to 175 pounds water, oil and gas and at temperatures up to 125° F. It is usually made of cast iron, though the combination cover and packing gland may be of forged steel.

The lubricant screw is located in the top of the operating shank and the plastic lubricant is inserted at this point, being forced into the body of the valve by applied pressure. The lubricant moves through the carrying grooves to the annular space below the plug where it exerts a pressure from beneath the plug and lifts it from its seat. This forced upward movement of the plug, which actually is very slight, merely loosens the plug and causes its flat top to compress the resilient packing just beneath the combination cover and packing gland. Another result of this movement is the uniform spread of the lubricant over the entire surface of the plug itself, and the builtup hydraulic pressure is dissipated somewhat into the line. At this point the compressibility factor of the packing becomes greater than the reduced pressure underneath the plug causing the packing to expand and reseat the plug. The packing is an asbestos composition which, with the resilient synthetic packing ring, acts like a spring to bring about this counteracting movement.

In maintenance of valves of this type, importance of the packing gland needs to be stressed. If this gland is out of adjustment and the plug is forced up against it, the plug will remain in that position because the resilience of the gland has been so impaired by improper adjustment that it cannot return the plug to its seat. The packing gland must be kept snug at all times or the valve cannot function properly. Packing glands are easy to install and should be inspected regularly at frequent intervals, especially when used in service involving wide temperature changes.

Intermediate Valve

Figure 1 shows an intermediate type valve in which it will be noted that the packing gland is of screw construction separate from the cover although the method of internal lubrication is the same. A gland of this type will give more positive action than that used in the standard valve. This type valve is made for working pressures up to 800 pounds per square inch, but it is not recommended for pressures above that figure. It is made of either iron or steel for different uses, but the iron valve should not be used for temperatures above 150° F. nor much lower than average atmospheric temperatures. The valves of steel construction will stand much lower temperatures and are frequently used in refrigeration units.

Valves of the intermediate type are in sizes from one-half inch to 24 inches. Usually those of six inches or larger have a bolted gland instead of the screw type. Three bolts hold the packing gland of the larger valves and care must be exercised in maintaining an even tension on all of them because an uneven pressure will almost invariably result in improper operation of the plug. This is an important point to all repair operators.

High-Pressure Valves

Figure 2 shows a cut-away, high-pressure type valve and illustrates a departure from the construction of the other two valves. Note that the plug is inverted and is inserted in the body from the bottom rather than from the top and that the mechanical packing gland has been eliminated. The method of sealing against external leakage is done by injecting an asbestos fiber packing, by use of an Allen screw through a ball check into the body of the valve and forcing it into an annular groove around the threaded operating stem. This design of valve can be repacked under its full operating pressure. The operating stem and plug are connected by a yoke which is known as the equalizing ring which fits loosely to eliminate pressure thrust and permit a so-called floating action of the plug. The plug operates on a steel bearing to give freer operation due to minimum drag. In this type of valve, instead of creating a lifting action, a thrust is set up on the top of the tapered plug as the lubricant is applied by means of a screw or high-pressure gun. In the type of valve illustrated, the bottom assembly or

cover is made of boiler plate in a calibrated thickness, which holds the plug in its seat. Through this bottom assembly plate, an adjusting screw is inserted which contacts through the diaphragm the steel bearing previously mentioned, which is centered at the bottom of the plug. After the plug is adjusted to its seat, lubricant pressure is applied, thrust is exerted, and the plug is jacked from its seat, which causes the bottom assembly to flex approximately 0.002 to 0.003 of an inch. As the plug leaves its seat the lubricant within the valve spreads to cover the plug area. As in the preceding types of valves discussed, the hydraulic pressure dissipates due to clearance created between the plug and body, and as this pressure dissipates, the bottom assembly snaps the plug back into its seat.

These valves are made of special alloy steels for working pressures ranging from 150 pounds ASA to 10,000 pounds WOG, and for temperatures ranging from minus 150 to 1000° F. These special alloys are also used for some of the intermediate valves where steam jackets may be required for use at low temperatures and for other purposes. Both types are sometimes made for automatic operation by motors or hydraulic pressure.

Proper maintenance and operation of all these valves should be the responsibility of specially trained men who thoroughly understand the importance of good valve operation. Check charts like those used in service stations for the lubrication of automobiles, are available for similar service for valves. These are convenient and completely authoritative guides to proper lubrication. Many companies use charts consistently, not only as reference guides but as training texts for their men, where they have been found to pay for themselves in reducing to a minimum failures of valves in operation.

Maintenance Tips

1. After servicing a valve, take a small portion of lubricant and seal around the screw so that sand or dust and water will not be permitted to get into the threaded recess and cause galling of threads.
2. Check glands frequently, and especially at seasonal changes, on the standard or intermediate type of valve. Check operating temperatures and always be sure that lubricant being used is made for the temperatures encountered.
3. After servicing valve, be sure that valve lubricant chamber has been freshly packed so that valve can be given quick charge of lubricant in case of emergency.
4. Valves should be tagged with the proper lubricant number to be used. This will eliminate a great deal of trouble.
5. Always use wrench that is made for the valve, as pipe wrenches ruin the operating shank and in many cases crack same.
6. After valves have been lubricated, plug should be moved in both directions freely. This will be good insurance for quick and easy operation.
7. Always be sure that gland is kept snugly in its seat.
8. In case of bolted glands, be sure that tension is applied to all studs evenly.
9. In dismantling valve, never remove all bolting unless plug is free and movable.

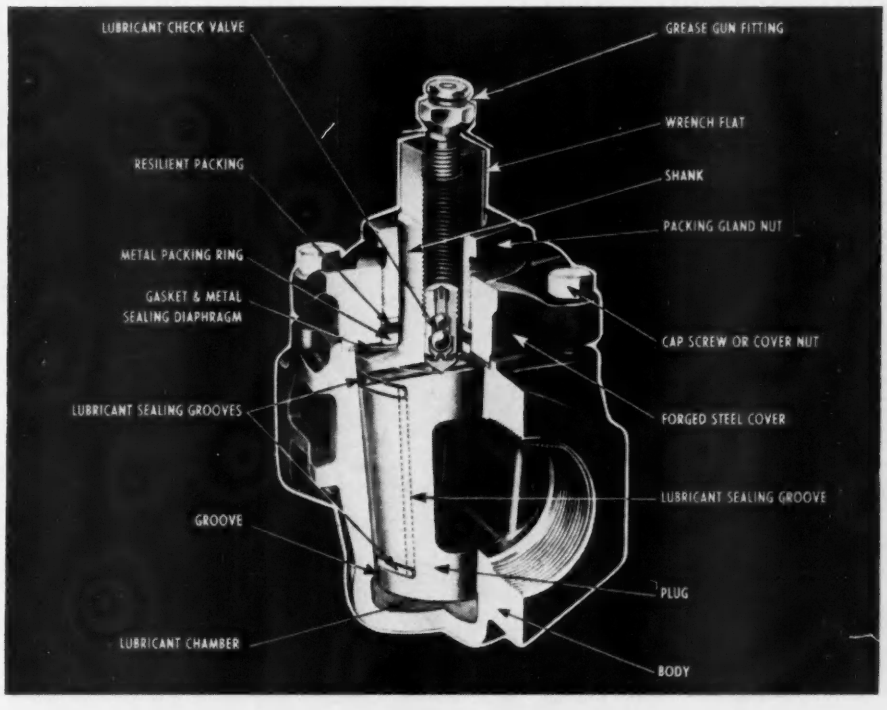

FIGURE 1. Cutaway view of intermediate pressure valve up to and including 800 pounds WOG. Relatively low temperature not to exceed 250° F.

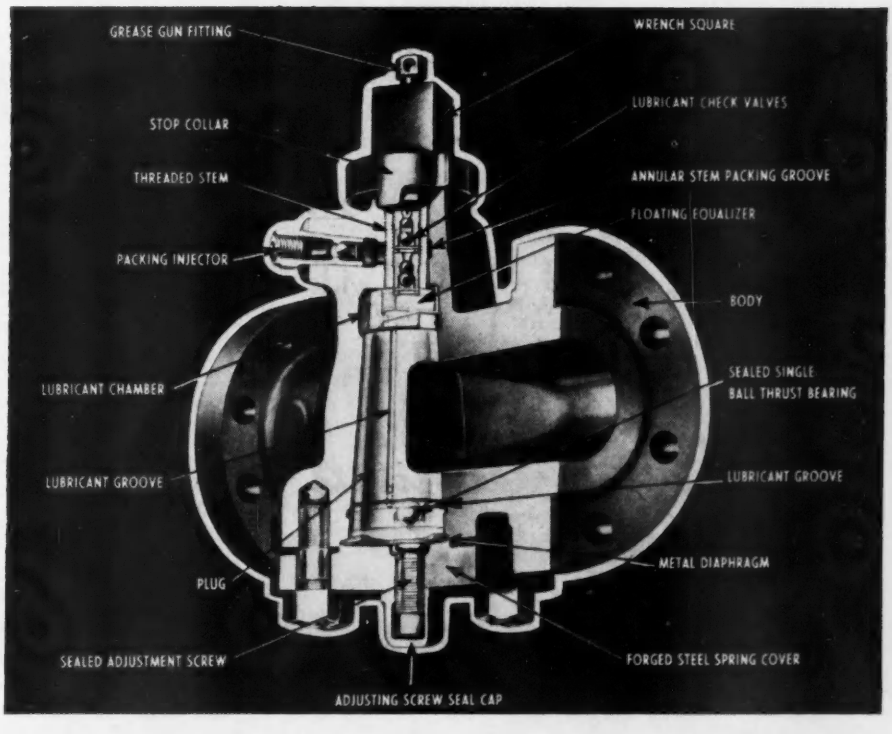

FIGURE 2. Cutaway view of high pressure valve, up to and including 10,000 pounds WOG and maximum temperature 1000° F.

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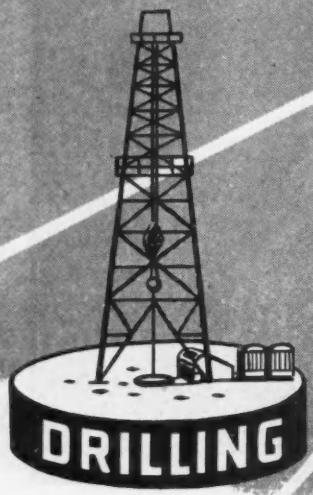

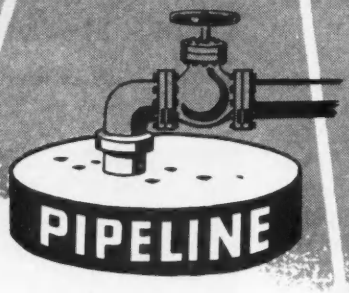

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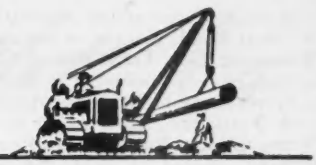


By SYLVIA LILLIE, Staff Writer

Projects Announced and Contracts Awarded

Crude Oil Lines

Basin Pipe Line System plans to increase its capacity from 240,000 to 340,000 barrels per day by building eight pump stations.

The Ohio Oil Company has awarded contracts for 226 miles of line between Wood River, Ill., and its Harlos Gate plant, Ind. Bechtel Corporation, San Francisco, will build 54 miles, and Conyes Construction Corporation, San Pablo, Calif., will build the remainder. This section of Ohio's Wood River-Lima line is scheduled for completion in 1950.

Platte Pipe Line Company plans a 1078-mile line between Worland, Wyo., and Wood River. The 140 miles from Worland to Casper, Wyo., will be 16-inch, and 938 miles from Casper to Wood River will be 20-inch. Two pump stations at Casper will give the line a delivery capacity of more than 70,000 barrels to Wood River. Ohio's Big Horn Basin system will be connected into the line at Worland, and Sinclair Refining Company's lines from the Wertz, Lost Soldier, Sand Draw, and Salt Creek field will join it at Casper.

Shell Caribbean Petroleum Company, in conjunction with The Texas Company and Mene Grande Oil Company has been authorized to build a 150-mile, 30-inch line from the companies' joint Palmarejo terminal north of Maracaibo to Las Piedras and Cardon on the Paraguana Peninsula.

West Coast Pipeline Company, formed by about 50 independent operators, expects to build 1100 miles of 20-inch from Monahans, in the Permian Basin, West Texas, to Los Angeles. The line, with a capacity of 200,000 barrels per day, could be used for products if necessary.

Products Lines

Plantation Pipe Line Company proposes to build 432 miles of 18-inch between Baton Rouge and Bremen, Ga., and 275 miles of 14-inch between Bremen and Charlotte, N. C. This line, which will increase Plantation's capacity to 167,000 barrels per day, will parallel the present line to Charlotte.

Natural Gas Lines

East Ohio Gas Company has awarded to Tulsa - Williams Company, Tulsa, the contract for a 24-mile, 20-inch line from Tennessee Gas Transmission's line at Petersburg, Ohio, to East Ohio's Austintown station.

Georgia Natural Gas Company applied for permission to build a 335-mile line from Southern Natural Gas Company's facilities near Phenix City, Ala., to Tallahassee. A similar request was withdrawn by Georgia Natural in May.

Hope Natural Gas Company plans 20 miles of 18-inch from its Tonkin compressor station in Doddridge County, W. Va., to the Fink storage area. The line, with a capacity of 100 Mmcf, would permit an ultimate increase of 25 billion cubic feet into the storage area.

Kansas Nebraska Natural Gas Company has temporary FPC authority to increase its capacity in Kansas and Nebraska to approximately 146 Mmcf by replacing 47 miles of line with larger pipe, by looping a line southwest from Palco, Kansas, and by installing 1640 horsepower in existing stations.

The Manufacturers Light and Heat Company has been given temporary FPC authority to construct 48 miles of 4- to 16-inch line at various points on its system in Ohio, Pennsylvania, and West Virginia, and to install two new 500-hp units at an existing station.

New York State Natural Gas Corporation received temporary authorization to build 63 miles of 20-inch from Westmoreland County, Pennsylvania, to the Pennsylvania-Ohio line. The East Ohio Gas Company is authorized to build a one-mile, 20-inch connection in Ohio to take gas from New York State Natural.

North Central Gas Company has applied to FPC for permission to build 35 miles of 6- and 8-inch line from Huntsman field to Northport, Neb., and a 13-mile line from Northport to Bayard.

Northern Indiana Fuel & Light Company asked FPC authority to build 31 miles of eight-inch to serve communities in northeastern Indiana from a connection with Panhandle Eastern Pipe Line Company's line.

Prince George's Gas Corporation has been authorized to build 20 miles of 22-inch from Atlantic Seaboard Corporation's line at Rockville, Md., to its Chillum, Md., compressor station for delivery to Washington Gas Light Company and its subsidiaries.

Shenandoah Gas Company applied for FPC permission to build 38 miles of 8-inch and 11 miles of 3- and 4-inch to take gas from Virginia Transmission Corporation's line near Cedarville to several communities in Virginia and West Virginia. Plans include the building or purchasing of distribution systems in these communities, if possible.

South Georgia Natural Gas Company has made application to construct a 527-mile line from Southern Natural Gas Company's system in northern Georgia into Florida. The proposed line may be connected with Transcontinental Gas Pipe Line Corporation's line, in which case an additional 53 miles of pipe will be required.

Western Natural Gas Company plans to lay a 20-mile, 12-inch line from Jumping Pound field to Calgary, Alberta. Shell Oil Company will build a gas gathering system in the field to supply Western Natural.

Projects Starting

Crude Oil Lines

American Petroleum Company in September started 11 miles of eight-inch from Sour Lake to Arriola, Texas. Latex Construction Company, Houston, is the contractor.

Magnolia Pipeline Company in August started 30 miles of 4- through 10-inch gathering system in the vicinity of Holly Beach, La. J. R. Stewart Construction Company, Houston, is contractor.

Ohio Oil Company is building 172 miles of 20- and 22-inch line from Vandalia, Ill., to Carlos, Ind. Conyes Construction Corporation, San Pablo, Calf., started in September.

Winnipeg Pipe Line Company, Ltd., (a subsidiary of Imperial Oil Company, Limited) is at work on 75 miles of ten-inch from Interprovincial Pipe Line Company's line at Gretna to Winnipeg, Manitoba. Sparling - Fowler Company, Ltd., Edmonton, and Fred Mannix and Company, Ltd., Calgary, started in August.

Products Lines

Essaness Corporation has started a 57-mile eight-inch line from Springfield to Lima. Tulsa Construction Company, Inc., is contractor.

Natural Gas Lines

Central Kentucky Natural Gas Company started in August 41 miles of 20-inch loop from North Means to Foster, Ky. Williams-Austin Company, Pittsburgh, is the contractor.

City of Kountz in September started 14 miles of four-inch in Kountz, Texas. Barry Construction Company, Houston, is contractor.

El Paso Natural Gas Company is building 99 miles of 30-inch from Deming, N. M., to Tucson, Ariz.

Mississippi River Fuel Corporation is building a 40-mile, 20-inch line from Dubach to Perryville, La. Mary Construction Company, Inc., Cape Girardeau, Mo., started in September.

New York State Natural Gas Corporation is at work on 27 miles of 20-inch from Westmoreland County to Bakerstown, Penn. Williams-Austin Company, Pittsburgh, started in September.

New York State Natural Gas Corporation in September started 27 miles of 20-inch from Westmoreland County to Bakerstown, with Williams-Austin Company, Pittsburgh, contractor; and 40 miles of 20-inch from Bakerstown to Ohio, Penn., with Tulsa-Williams Company, Tulsa, contractor.

Ohio Fuel Gas Company is at work on a 22-mile, 16-inch line from Centerville to Dayton, Ohio. Ohio Pipe Line Construction Company, Greenville, Ohio, started in September.

Panhandle Eastern Pipe Line Company is building 85 miles of 4- through 12-inch line from Dumas to Hugoton, Texas.

Knupp Construction Company, Inc., Great Bend, Kansas, is contractor.

Tennessee Gas Transmission Company is building 57 miles of eight-inch from Greensburg to Brandenburg, Ky. Brown & Root, Inc., Houston, is contractor.

Texas Illinois Natural Gas Pipeline Company started in early September 420 miles of 30-inch to run across Arkansas, Mississippi, and Missouri.

United Gas Pipe Line Company is at work on 23 miles of 16-inch from Mud Lake field to Port Arthur, Texas, with Texas-Southern Contracting Company, Fort Worth, as contractor; and 41 miles of 12-inch from Laurel to Meridian, Miss., to be built by Brown & Root, Inc., Houston.

Projects Completed

Crude Oil Lines

Interprovincial Pipe Line Company completed a 30-mile, 16-inch line from Redwater field to Edmonton, Alberta. Williams Bros. Ltd. (Canada), Edmonton, was contractor.

Mid-Valley Pipe Line Company completed in September two spreads of 22-inch main line: Sections 5B and 6A—111 miles from Clarksville, Tenn., to Elizabethtown, Ky. Britton Construction Company, Weatherford, Texas, was the contractor. Section 6B—22 miles from Elizabethtown to Mount Washington, Ky., built by Eastern Construction Company, Dallas; and 89 miles from Mount Washington to Hebron, Ky., finished by H. L. Gentry Construction Company, Jackson, Mich.

Pan American Pipe Company completed in August 23 miles of 4- and 6-inch gathering system in the vicinity of Snyder, Texas. W. L. Golightly Construction Company, Houston, was the contractor.

Portland Pipe Line Corporation and **Montreal Pipe Line Corporation** expect to complete by October 1, their 234-mile, 18-inch line from Portland, Me., to Montreal, Quebec. Eighty-five miles from Portland to Gorham, N. H., were built by Oklahoma Contracting Company, Inc., Dallas; 81 miles from Gorham to North Troy, Vt., by Associated Pipeline Contractors, Inc., Houston; and 70 miles from North Troy to Montreal were built for Montreal Pipe Line Corporation by Fred Mannix & Company, Ltd., Calgary, Alberta.

Sun Pipe Line Company completed in September 16 miles of 6-inch from Nona Mills, Hardin County to Saratoga station, East Texas. Joe Titsworth, Kilgore, Texas, was contractor.

Natural Gas Lines

East Tennessee Natural Gas Company completed in September 123 miles of 12-inch between Tullahoma and Athens, Tenn. N. A. Saigh Company, San Antonio, was contractor.

Montana-Dakota Utilities Company and **Montana-Wyoming Gas Pipe Line Company** finished their 340-mile, 12-inch line from Worland field, Wyo., to Montana-Dakota's Cabin Creek station, Mont. It was completed in September by Conyes Construction Corporation, San Pablo, Calif.

Northern Natural Gas Company completed a 37-mile, ten-inch line from Ames to Marshalltown, Iowa, built by Knupp Construction Company, Inc., Great Bend, Kansas; and a 33-mile, 26-inch line from Mullinville to Belpre, Kansas, built by R. H. Fulton & Company, Lubbock, Texas.

Panhandle Eastern Pipe Line Company completed in September 16 miles of 26-inch in the vicinity of Decatur, Ill. Anderson Bros. Corporation, Houston, was contractor.

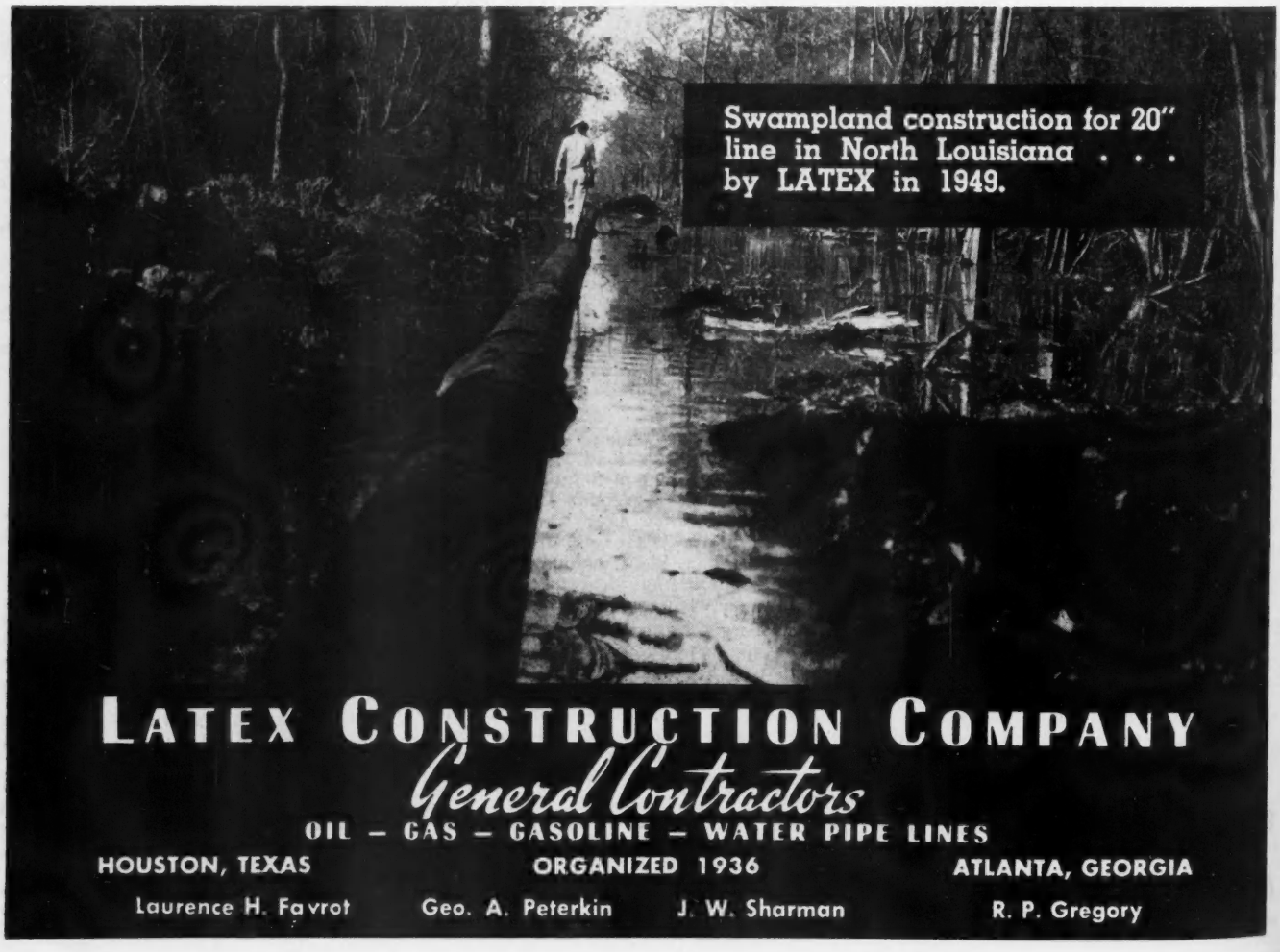
Southern California Gas Company completed in September an 80-mile, 30-inch line from Whitewater to Puente, Calif. Midwestern Constructors, Inc., Tulsa, Johnson Western Gunite Company, San Pedro, and L. E. Dixon Company, San Gabriel, Calif., were contractors.

Southern Natural Gas Company completed in August 24 miles of 24-inch loops in Mississippi, Alabama, and Georgia. Sheehan Pipe Line Construction Company, Tulsa, was contractor.

Tennessee Gas Transmission Company completed in September a 75-mile, 26-inch loop from near Morehead, Ky., to the Ohio River, and from Load, Ky., to Catlettsburg, Ky. Anderson Bros. Corporation, Houston, was contractor.

Texas Gas Transmission Corporation completed in September a 32-mile, 12-inch lateral from Slaughters, Ky., to Evansville, Ind. J. Ray McDermott & Company, Inc., Harvey, La., was contractor.

Transcontinental Gas Pipe Line Corporation completed in September Section 9 of its main line—100 miles of 30-inch from the Catawaba River to Spray, N. C., built by R. H. Fulton & Company, Lubbock, Texas; 58 miles of 4- to 14-inch gathering laterals in the El Campo, Texas, area, built by T & R Construction Company, Houston; 98 miles of 6- to 14-inch gathering laterals in the vicinity of Wharton, Texas, built by Altgelt Construction Company, Corpus Christi.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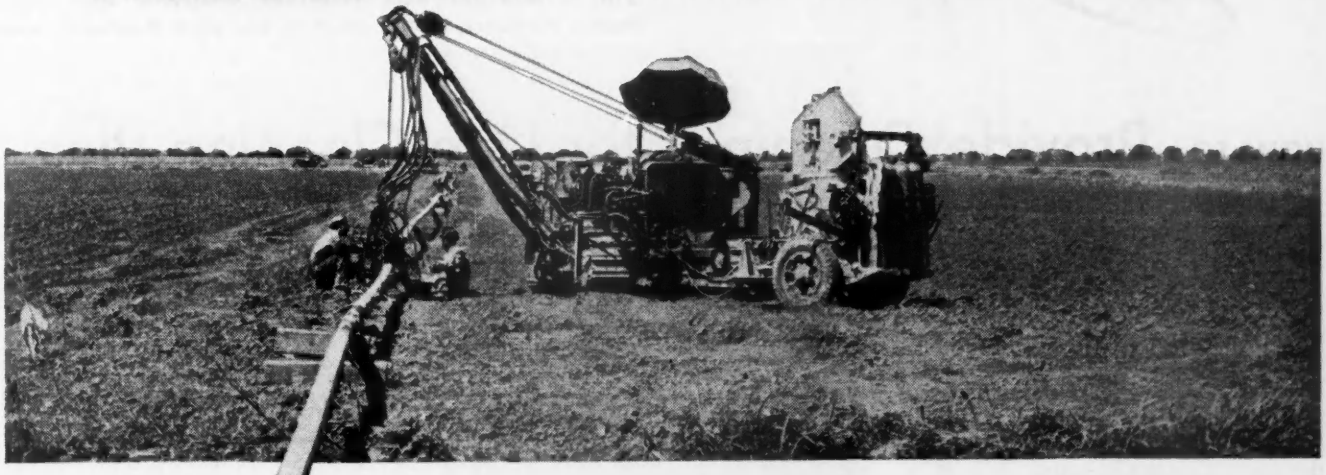

another Republic Electric Weld Pipe Line.. 81 miles long

Straight lengths that line up evenly and go into the ditch freely helped speed construction of this 4½" O.D. pipe line in Waller County, Texas. As this line is designed to operate at 1000 pounds per square inch pressure, the uniform high yield strength of Republic Electric Weld Line Pipe is vital, too.

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5. **Uniformly Straight**—Lengths line up evenly . . . go into the ditch freely.
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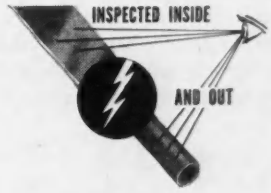
10. 

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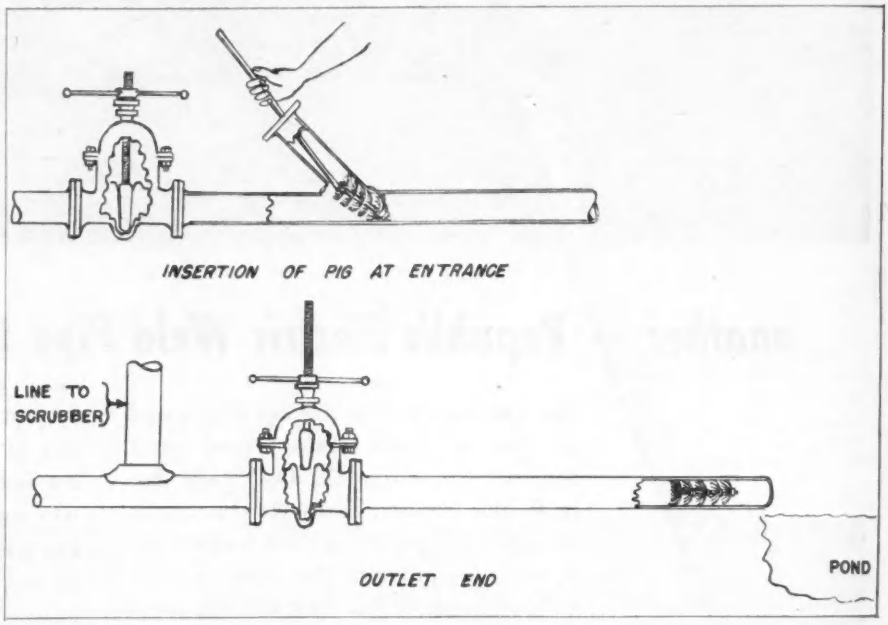
HOW TO—Provide Openings for Line Cleaning Pigs

On a five-mile section of a six-inch natural gas pipe line much difficulty was encountered in cold weather by clogging of the line with frozen hydrates, crude oil sediments, etc., because the gas transported by the line was obtained from combination oil and gas wells. Pigging the line at frequent intervals as needed proved to be the most satisfactory means of keeping the line cleared for operation.

The operators devised an inlet for inserting the cleaning pig in a gate valve pit, as shown. The outlet end for the pig was at a scrubber setting five miles farther down the line. The open end (outlet) was made to point into a sediment receptacle (small pond).

The entrance for the cleaning pig was made by welding a 45-degree saddle, of equal diameter, to the top side of the pipe line after cutting an elliptical hole. A nipple with a single eight-bolt flange was welded to the projecting end. A blind mating flange with gasket was used as a cover for the pig entrance after insertion had been made.

By using a short cleaning pig (8 inches) little difficulty is experienced in getting it around the 45-degree bend into the pipe line, since there is enough resilieny in the rubber rings and the steel scraping bristles to permit negotiation of the turn if a little force is used on the poking stick.

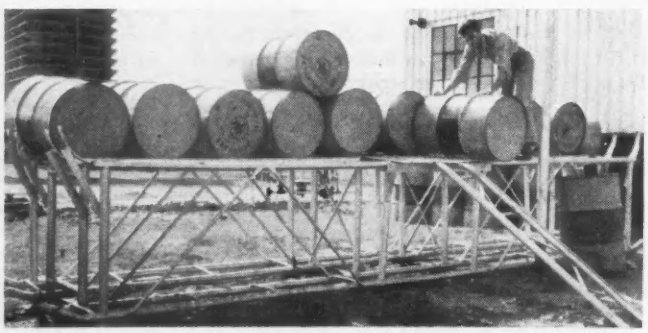


Full rising wedge-type gate valves installed throughout the section of the pipe line to be pigged permit the pig to pass through them unimpeded.

Because the line described has to be cleaned several times every winter, such a permanently installed entrance and outlet for the cleaning pig eliminates cutting the line and bending it to get the pig into the line.

HOW TO—Make Drum Storage Rack for Station Use

A simple convenient rack to unload and store oil drums may be fabricated from materials usually found in the pipe yard. The rack's two sections are made of 1-inch and 2½-inch scrap pipe. Eight joints of 2½-inch pipe are selected and the 4 longer joints are heated and bent up on the ends to form skids so that the rack can be conveniently moved.



Upright pieces of 2½-inch are then welded between the long pieces to make the top members the height of a truck bed. The sections are braced with 1-inch pipe as shown. Short pieces of strap iron are bent and fastened to the ends of the top runners to keep the drums from rolling off the rack.

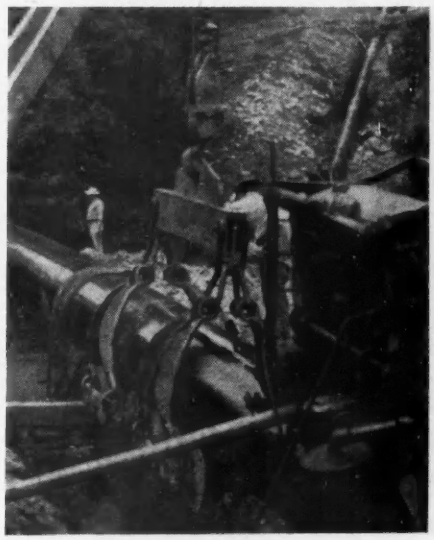
A set of skids is fastened to one side of the rack so that drums may be rolled down from the rack and to the engine room as needed. Both racks are fastened together with cross pieces so that two rows of drums may be racked at the same time. The empties are kept on one rack and the full ones on the other. Whenever a truck load of empties is obtained, the bulk station truck brings out a new supply.

HOW TO—Adjust Load on Rollers

Increase in diameter of trunk pipe lines, with little or no added thickness to the pipe wall, imposes a severe deforming stress on the metal when the pipe is supported at only a few points. To avoid this overstressing and possible deformation of the pipe wall, multiple rollers are supplied. These rollers must be so linked that uniform weight distribution over the entire assembly is assured, as otherwise much or all of the load may be thrown on one or two of the rollers and distribution unbalanced.

One contractor, in addition to the multiple rod linking connecting the 3 axles of each roller unit, connects these units to a beam which, in turn, has pivoted connectors and links to allow the 2 side members of each roller carriage to be equalized. Further adjustment is provided by welding a heavy piece of steel plate across the top of the main beam, with a centralized hole through which the hook from the side-boom lift is placed.

Thus equalized, each roller assumes its share of the pipe load, and the pipe wall and/or prime coat in direct contact with the roller is subjected to no more than the designed load.



—Photo courtesy H. C. Price Company

HOW TO—Lock Pipe Line Valves

On temporary installations where the oil is being pumped into trucks until a pipe line is laid, a lock may be fashioned for 2-inch gate valves with a short piece of 6-inch pipe. Using a piece approximately 2 feet long, one end is blanked off by a plate welded over the end.

Into the other end, two slots are cut approximately 2½ inches wide to allow the "bonnet" to fit down over the valve. Slots are then cut in either side of the lower edge of the bonnet and a bar cut out to fit through the slots. One end of the bar has a head welded fast and the other end is slotted so that a lock or gauger's seal may be inserted.

When the gauger comes to open up the tank and start the pump, he can easily

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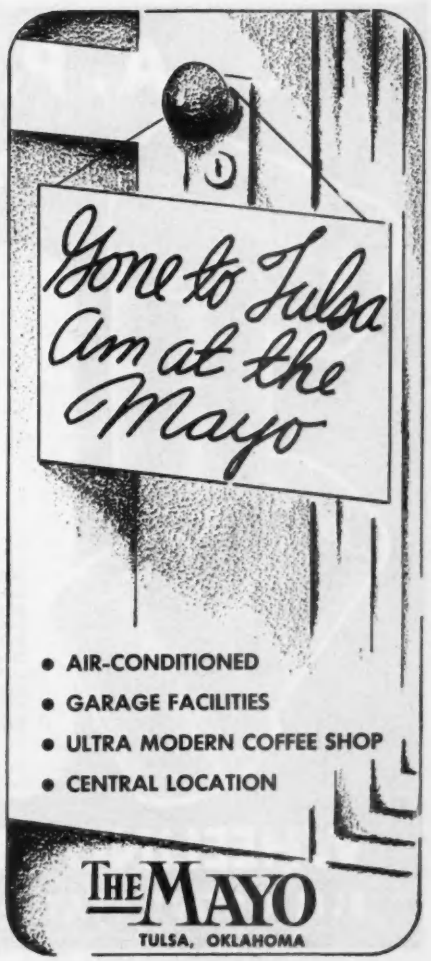

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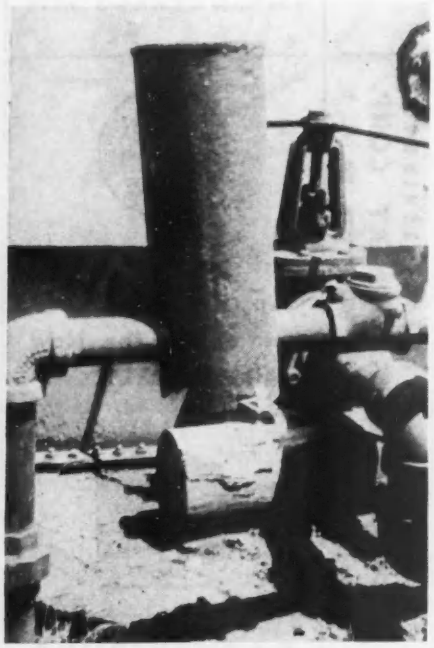
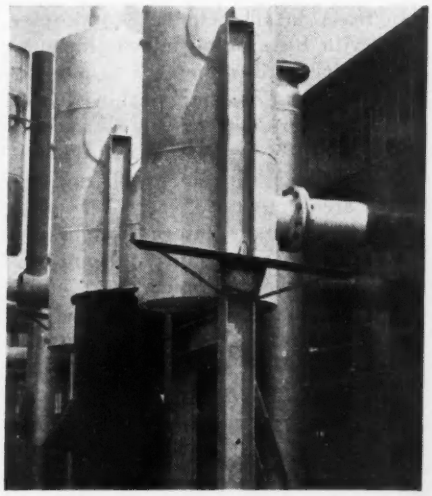


break the seal or open the lock and lift off the bonnet to open the gate. While the tank is on the line, the valve may be locked open to prevent tampering.

HOW TO—Brace Service Platform

At one pipe line station mufflers are cleaned and repainted at frequent intervals, as otherwise atmospheric conditions combine with the elevated temperature of the outer shell to cause rapid corrosion and serious damage to the installation.

Instead of employing the usual wooden horses and scaffolding for the men engaged in the muffler reconditioning, the company fabricated a pair of special brackets to fit the wide flange I-beams used as muffler supports. These supports may be raised to the desired height and clamped to the vertical beams through the use of set screws in the bracket center member. Two brackets, on facing pairs of the muffler supports, carry specially cut scaffold planks which extend across the gap between 2 mufflers, with the outer planks being allowed to extend past the base of the muffler shell to enable one-half of the shell to be completed at one setting of the scaffold.



Ears or wards welded to the ends of the horizontal member carrying the scaffold planks prevent side displacement of the boards, and insure the safety of the maintenance crew.

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PIPE LINE HINTS

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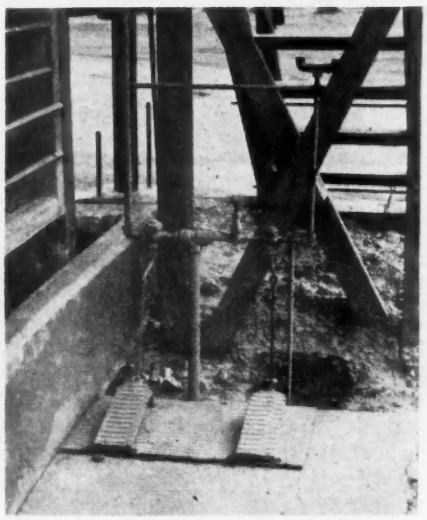
Install Eyebath for Workers' Protection

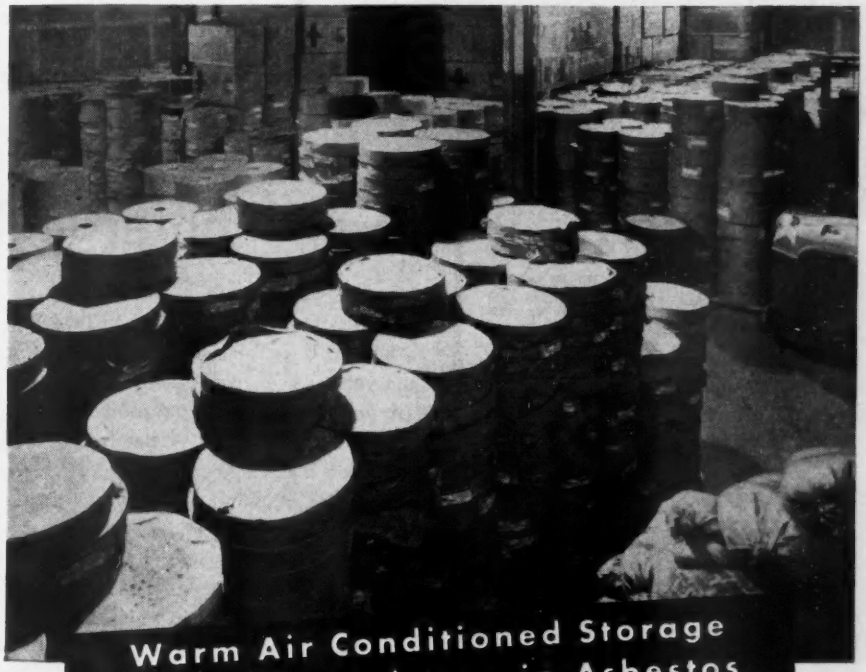
As a convenience for men who work in contaminated atmosphere, or in contact with corrosive chemicals, many plants supply a shower bath which may be operated almost instantly to dilute and wash away any matter which causes irritation or damage to the skin. Going further, one company provides, in addition to this shower, a fixture which may be operated by a foot throttle to provide a means of flushing the eyes of the employe. This is installed at the same location where the shower is placed, but to one side. The water supply is obtained from the same pipe line which serves the shower.

A short pipe nipple, bringing the shower to a convenient height, terminates in connections including a bull headed tee, fitted with all-thread nipples on either side with ells looking up. This connection separates the openings of the ells to approximately the width between the average eyes. To operate, the person steps on the foot throttle as he bends over the eyebath. A controlled quantity of water flows into the eyes and over the face to clear away the irritant.



The bath is also an excellent means of removing sand and dust, or other insoluble substances which may blow with the air into the eyes of the men working in the area.

The foot pedal at right is hinged to a piece of floor plate which also mounts the shower pedal. The pedal is linked to a spring-loaded globe valve which is supported on a horizontal run of three-fourths-inch pipe. The vertical rod near the valve serves to support the small pipe when pressure is exerted on the foot pedal.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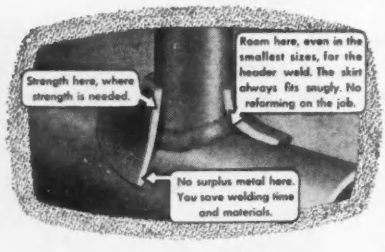
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HOW TO— Enlarge Indicator Pane

Large pipe line valves buried below the ground surface, and controlled by rotating the valve wheel placed above the ground, are provided with a visual indicator which enables the operator to determine when the valve is open or closed, or any degree in between. A pointer rides on a threaded stem which rises up and down with rotation of the valve wheel. Limits of the pointer are marked open and closed. The slotted opening through which the operator looks to check the position of the pointer is limited by a cast frame which holds in the place a thin sheet of plastic which prevents the entry of dirt and moisture over the valve stem inside the outer cylinder.

When these panes become clouded it is difficult to locate the pointer. They can be replaced with a piece of thick, clear lucite which requires no metal frame to hold it in place. By eliminating the frame, more light is allowed to enter the slotted opening, and the operator has a clearer view of the gate position indicator. A gasket is

used under the lucite window and it is secured with the regular bolts.

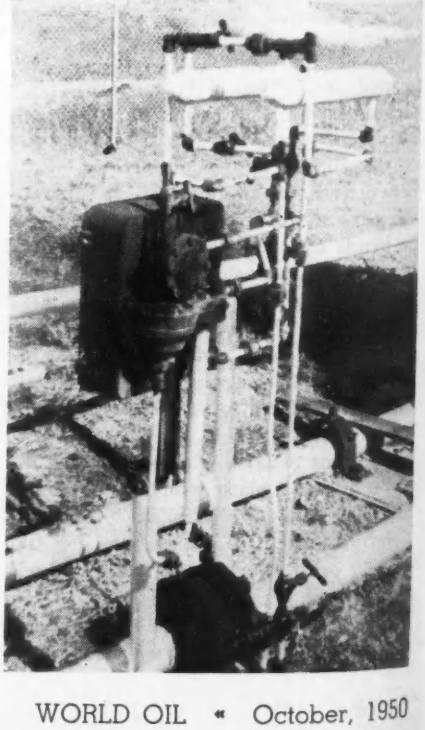
HOW TO— Protect Meter Piping

Meter piping in which hydrates form can be protected from freezing by a blanket of antifreeze on top of the mercury chambers. Each side of the meter is connected to the orifice flange through a surge chamber in which the antifreeze is placed.

Each chamber is filled half full so that the level in each is the same when the meter is out of service. When the meter is placed back in service and a differential through the orifice is obtained, the antifreeze rises in the chamber on the upstream side and falls in the chamber on the downstream side.

Condensation in the piping may dilute the antifreeze, but seldom does the set-up have to be disturbed during the winter season after being placed in service in the fall.

This arrangement has proved so satisfactory that it has become standard equipment for one company wherever meters tend to freeze.



Mexico's Oil Activity On Upgrade

New refinery under construction at Reynosa will be in operation by mid-December.

MEXICO's petroleum operations are on the upgrade at mid-year according to government officials. This announcement was followed by a notice from President Aleman, September 1, that Mexico had been granted a $150 million loan from the U. S. The loan was made primarily to finance the construction and improvement of railroad and highway facilities, aid agriculture, irrigation, electric and telecommunications projects. Indirectly, the loan will assist the Mexican oil industry by the transfer of funds earmarked for these projects to oil production work. This is the climax of loan negotiations which were started last year between the two countries and which were later dropped because of increasing opposition to the loan in the U. S.

Meanwhile, Mexico has been stepping up its activities in petroleum work in most departments. The Salamanca 30,000 barrel refinery, as described in the July WORLD OIL, has been opened by Petroleos Mexicanos, official government oil agency. Senator Antonio J. Bermudez, head of Pemex, announced that a new refinery being built at Reynosa, near the Texas border, was nearing completion and would probably be inaugurated December 15. The refinery will serve the northeastern industrial area of Mexico which is rapidly developing into an important agricultural and manufacturing center. In conjunction with this refinery a new pipe line is being laid from the Reynosa fields to Monterrey, which is one of the more important manufacturing centers of Mexico today.

On September 1, President Aleman announced that oil production in Mexico had soared to 215,000 barrels per day as compared with the 193,123 barrels daily reported for April of this year. Crude oil and gas production was up, as well as development drilling and refinery runs. Broken down to half-year figures, Mexico's oil operations show an increase in most categories over 1949 (Table 1).

TABLE 1

	1st Half 1949	1st Half 1950
Production:		
Crude Oil	28,217,269	34,614,890
Distillate	28,204	16,348
Gas*	4,440,934	5,336,763
Total	32,686,407	39,968,001
Refinery Runs	27,989,904	30,690,383
Wells Drilled:		
Exploration	12	5
Development	56	77
Total	68	82
Footage Drilled:		
Exploration Wells	94,403	41,747
Development Wells	187,678	304,926
Total	282,081	346,673

* The gas is all utilized, and the figures are the calorific equivalent of the gas on the basis of 5000 cubic feet for a barrel of crude petroleum.

Mexico will have its regular presidential elections next year and oil may play an important part in the campaign. President Aleman has gained the confidence and respect of his people by his aggressive development of Mexico's agricultural and industrial facilities. As a result there has been increasing pressure put on him to consider running for re-election. Re-election is banned by the constitution, which permits presidents to serve only one six-year term. The constitution would have to be amended to permit Aleman's nomination, and such an amendment would undoubtedly touch off explosive political battles throughout the country. President Aleman scotched all re-election talk on September 1 when he said he would not consider running for another term even if the constitution were amended —and he asked that this not be done.

This leaves the presidential race open to about seven prominent candidates, among whom is Senator Bermudez, director general of Pemex. Bermudez has a considerable following in the oil industry, and, if he runs for office, will undoubtedly base much of his campaign on the development of the oil industry under his supervision.

CARE and MAINTENANCE

# of Canvas Wind Breaks On Drilling Rigs

—Photo courtesy E. L. Oliver, Okla. City.

RAPIDLY becoming an integral part of drilling rigs in cold climates, wind breaks can be an expensive necessity if not treated with the utmost care and respect. Canvas wind breaks afford effective and economical protection for drilling crews and field personnel against the vagaries of weather and are useful in summer as well as in winter. Adaptability of canvas wind breaks has been demonstrated in Canada and Alaska where crews are subjected to sub-zero temperatures and inclement weather conditions. They are also being widely used in other parts of the world.

Field personnel should be familiar with the uses of canvas wind breaks and should know how to care for and maintain them, as any other drilling equipment. Although canvas represents an economical means of protecting men and equipment, it is nevertheless an item of expense and as such must be properly protected if the operator is to get the full benefit from his investment.

Field personnel sometimes are in a hurry or are careless in caring for and maintaining canvas wind breaks in good condition. There is nothing complicated about the procedure and proper care is easy — similar to taking care of an overcoat. The damage is done, however, when little or no attention is given to dismantling and storing canvas when not in use. Canvas wind breaks cost more than many of the most expensive overcoats and can be ruined just as easily.

Canvas, whether used to protect a drilling rig or a temporary structure, should be properly placed with the material stretched taut and properly fastened on hooks specially designed for this purpose. Driving nails into the material is a common but not a good practice and should be avoided wherever possible. Care should be taken when removing this protective material to prevent rips or tears. Canvas can gall and this results in rotting and deterioration.

When not in use, the canvas should be neatly folded and placed in a shed or warehouse. It should not be permitted to lay on the ground around the derrick where heavy trucks and tractors can run over it and tear or damage it. Although canvas is designed to withstand considerable punishment it is not necessary to accelerate deterioration by permitting the material to lie in mud or water and invite rot. If stored in a warehouse, it should be kept in a place where heavy equipment will not be placed on top of it. Since canvas is easily hauled away the wise warehouseman will keep it in the back of the warehouse to prevent theft.

Canvas Types

Canvas used for wind breaks around drilling rigs and on other structures such as dog houses and tool sheds, etc., is available in "water proof" and "flame proof" types. Drillers and tool pushers should recognize the difference, especially if canvas is to be used as a protective side wall where a stove may be nearby. Wherever there is any fire hazard the "flame proof" canvas should be specified. This type of canvas will char when in contact with extreme heat or fire but will not burst into flame.

Used as a wind break around a rig, canvas affords protection for men and equipment against cold, rain and the hot sun, and it also protects those working outside and near the rig from flying particles of metal from damaged equipment on the derrick floor. This is a real hazard as personnel injuries from flying metal from the rig floor have been reported.

The accompanying picture illustrates a drilling rig and derrick completely canvas equipped for the coldest weather. This is a specially constructed combination lean-to and gable type engine-house and pump shed which assembles into one unit. All frame work is slip-joint constructed for easy dismantling and compactness for transporting from one location to another. Canvas extends from base of derrick floor to the second girt of the derrick and canvas for the derrick man's platform covers the space between three girts.

Some operators use canvas engine-house frames and tops made of canvas in the summer to protect expensive equipment from rains and the hot sun. It is economical and handy, but in the long run it is only as good as the care it receives.

Over the East Indies

A Business Man Views

The Far East

By JAMES HERRICK
Vice President, Cardwell Manufacturing Company, Inc.

THE AUTHOR is in an excellent position to comment on the petroleum and political aspects of the Far East. This article is based upon his observations during two business trips to this important area. Piloting a twin-engined plane in 1947, the author flew from New York to Europe, the Middle and Far East, stopping in the last two areas about two months, thence on around the world. Last fall he flew a DC-3 over the same route to the Far East, stopped in Indonesia three months, and returned by way of India, the Persian Gulf area and Western Europe.

WITH 80 million barrels of crude oil yearly at stake, oil companies operating in Burma, Borneo, Java and Sumatra are greatly affected by the economic and political uncertainty created by the Communist invasion of South Korea and the constant threat of similar assaults on other countries in the Far East. Internal strife also caused by the Reds makes operations in the area doubly precarious.

To rebuild their war-damaged facilities and expand production, operators in the Far East would have to invest tremendous amounts of money. With many of their holdings now cut off by Communist rebels, the companies recognize the danger of building up what they now hold, if the Communists plan to take over the region entirely.

The petroleum industry, as any other, cannot operate in a region of political instability. Although it might be true that the companies took this calculated risk when they went into Far East countries, it remains that if they are forced to relinquish their concessions, Russia will be waiting to take over the 80 million barrels per year production.

The writer's personal interest in the Far East has to do with equipment. In general, that part of the world has been a relatively good market for drilling and producing equipment. There are numerous oil fields there, mostly producing from moderate depths, and since none of the wells are enormous producers, a great deal of drilling is carried on in normal times. This means a big market for drilling, servicing and producing equipment. It is true that some of the U. S. market is being cut by purchases in sterling areas, but this is due to the fact that most countries are becoming increasingly short of dollars.

The Far East has long been important to oil men and other business men engaged in operations in that area — more important, apparently, than it was to the policy makers in the U. S. government. In June, when the Communists in North Korea changed the cold war to a hot fight, this country was abruptly awakened to the importance of the Far East.

The writer does not attempt to

pose as an authority on the area, but having made two trips through southeast Asia in the last three years it has been possible to obtain some rather obvious views of the situation. Having just returned from a six months business trip through Europe, the Middle and Far East, the writer's impressions gathered there on the present political conditions may be of interest. Few people in the U. S. have been aware of the large stake America has in the Far East. It is a source of many raw materials needed by the U. S. both in peace and in war. The whole area is enormously rich in natural resources and it would be a rich prize indeed for the Communists who are ready and willing to take over. Both economically and politically there are good reasons for taking an intelligent and well-informed interest in the welfare of those Asiatic countries. Who controls these countries is hardly a matter of ideological wishful thinking any longer — if the U. S. does not take definite steps to help its friends hold their own lands, the Communists will almost certainly take over. There is not one case in which a compromise has been reached with the Communists.

The move into South Korea was a surprise to many people for several reasons. It was more logical to think the Reds would have moved into the far richer areas of southeast Asia. There is no guarantee that they will not do so in the near future, if the U. S. does not come to understand the situation and take appropriate steps to stop them.

To understand the present condition, it is a good idea to review a little of the history of southeast Asia. First, consider Indonesia — one of the truly dangerous political spots today. It was controlled by the Dutch for 300 years and the development of the area was largely due to the Dutch influence. The native population prospered and flourished during this period, although there can be no question that some of the methods of ruling the area could have been improved.

After the Japanese were pushed out of the area after the last war, the Dutch were militarily unable to regain control of Indonesia immediately. Partly as a result of Japanese political indoctrination, and partly as a result of the natural desire of the Indonesians to be independent, there was a great deal of resistance to the re-entry of the Dutch into the islands. If the Dutch had been left alone to carry out the task of reorganizing their former colony, Indonesia would not be the Communist stronghold it is today. For this condition the U. S. must assume a large share of the responsibility. Through the United Nations the U. S. joined with other countries in urging that the Dutch withdraw from Indonesia and grant the area its independence. Under this pressure the Dutch did withdraw and the Communists moved in.

American motives in the matter were idealistic but they were not very realistic for times such as these. It would please everyone if the Indonesians could have the independence they desire, but the area is not strong enough to keep its freedom in the power-grabbing world of today. For the Indonesians, it is now almost a choice between the Dutch and the Communists — and the Communists would make the Dutch period of rule seem like a Sunday picnic. The U. S. might have done better to urge the Dutch to modify their colonial policies and to give the Indonesians a greater voice in the government rather than to urge the Dutch to leave the area entirely.

In a normal, peaceful world the action of the U. S. in the Indonesia affair would have been commendable. While the people lack experience in self-government, they would have in time overcome the obstacles and eventually developed into a free independent nation. Instead, immediately following the Dutch withdrawal from active participation in the government, the area had a full-fledged civil war on its hands — led and inspired by the Communists. If the native Communists cannot take over the country, there is a good possibility that they will receive indirect or even direct help from Russia. The Russians and their Communistic stooges are on the march throughout the world filling every power vacuum they can find. Indonesia today is just such a power vacuum and there is little to prevent Russia from filling it. With the inadvertent assistance of the U. S., the Reds' chances of taking the area are very good.

While the writer was in the Far East, the U. S. appropriated $400 million of special aid for the Indonesian government and presumably more millions will follow. The U. S. government apparently still believes it can buy off a situation that probably cannot be purchased. The money which now goes to fight Communism perhaps would not be needed if the U. S. had not interfered with the return of Dutch rule to the area. The oil fields and other natural resources would be in the hands of friendly powers instead of being largely shut-off from the free nations as they are now.

America's show of strength and determination in Korea has been an enormous help to its prestige in southeast Asia. It will undoubtedly stiffen the native resistance to Communism, but the U. S. must do more. The country must regain its military strength in a hurry, and must make it increasingly clear to the Soviet Union that beyond this point the U. S. will not retreat.

Iraq and IPC Agree on Increased Oil Royalty

Agreement has been reached between the Iraq government and Iraq Petroleum Company for an increase in royalty rate from four gold shillings to six gold shillings per ton of crude oil produced for export. Confirmation of the agreement, first reported from Iraq, was given by one of the IPC partners in New York. IPC is a joint subsidiary of the Anglo-Iranian Oil Company, Shell Oil Company, French interests and American participants in the Near East Development Corporation, in turn jointly owned by Standard Oil Company (N. J.) and Socony-Vacuum Oil Company.

IPC has been paying the Iraq government four gold shillings a ton at the Bank of England buying rate, after devaluation, of about 11.6 shillings. Six gold shillings would be about $2.70.

Iraq computes that the increased royalty will yield about $47,600,000 additional revenue for the period January 1, 1950, to October, 1954, expiration date of the former exchange and royalty agreement. The settlement of the long controversy is said to have been aided by an understanding that the Iraq government will not seek further royalty increases in 1954.

Two IPC subsidiaries, Basrah and Mosul oil companies, are still negotiating an agreement and according to reports from Baghdad, these companies have been threatened with government seizure if they do not agree to increased crude production.

Iraq is pinning its reconstruction program on a greater volume of petroleum exports from the great Kirkuk field, producing in excess of 110,000 barrels a day, and from the new fields of Ain Zalah and other areas at the head of the Persian Gulf, around Basrah. Iraq's production has been shut in because of the Arab-Israeli controversy which resulted in closing the IPC pipe line system from Kirkuk to Haifa, Palestine.

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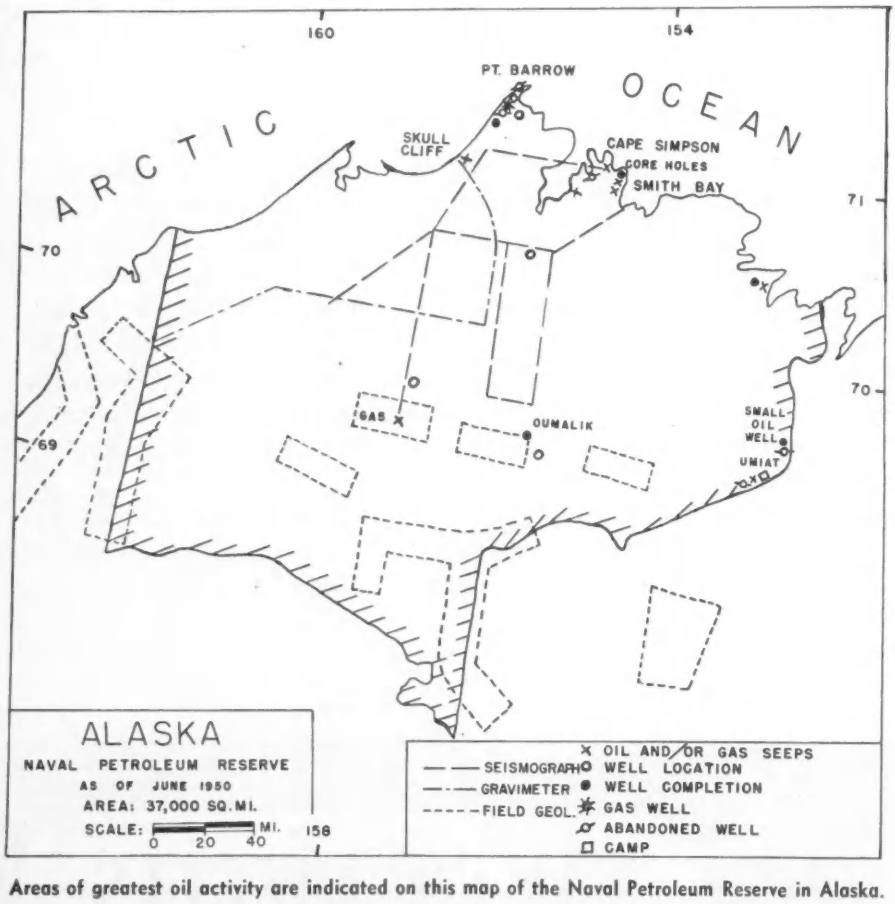
Alaskan Oil Search To Be Accelerated

ONE OF THE hot spots in U. S. military parlance is frigid Alaska, where activity is being stepped up to improve the defenses and develop the resources of the territory. In the Naval Petroleum Reserve No. 4, above the Arctic Circle, the search for oil is being stepped up during the short period of summer. The reserve had $11 million appropriated this year for petroleum development as compared with $3 million last year. The increase in funds is intended for increased drilling operations now that much of the geological and geophysical work contemplated is underway.

Two wells have been completed this year and four wells are presently drilling. The results on these wells have not been released, but most of the wells drilled in the reserve have had showings of oil and gas — without commercial production indicated. The wells drilled in the past two years have been located by data obtained from surface geology and seismic work, or are near oil or gas seeps. Drilling now covers the northern, central and eastern sections of the reserve and will probably be extended into the southern and western portions.

There are six geological and five seismograph parties now operating in the reserve and adjacent regions. A gravity meter crew is operating in the western part of the reserve which will wind up the coverage of the entire plains area in that section.



Areas of greatest oil activity are indicated on this map of the Naval Petroleum Reserve in Alaska.

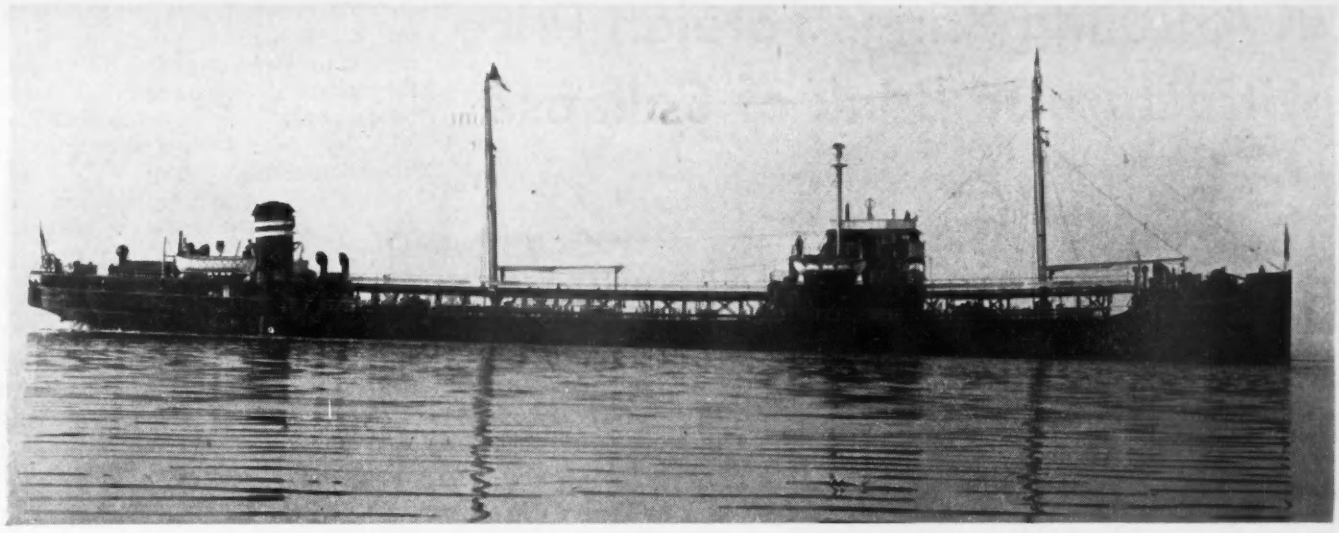
Navy Optimistic

The Navy expects to find oil in commercial quantities in the reserve, and because of the present vulnerability of Alaska to invasion from the north, most of the exact extent and location of the work being carried on is being kept quiet.

Oil is frequently found in the most inaccessible and desolate spots on the globe, and if this factor is a requisite for finding oil, Alaska should be a major producer. Food, supplies and personnel have to be carried to the reserve by air from Fairbanks, a town not noted for its balmy climate. The main camp at Point Barrow receives some of its supplies by water in the six-week period in the summer that the sea passage is ice-free. Field camps are supplied by plane and helicopter when weather permits and by dog sled and Army weasels when the planes are grounded. The short summer is characterized by almost continuous daylight and temperatures warm enough to thaw the frozen surface of the ground from 3 to 16 inches down. The long winter has few daylight hours and temperatures range from 30 to more than 50 degrees below zero. Despite the severe winter conditions, drilling operations are carried on in completely enclosed rigs and derricks.

About 600 personnel live on the reserve, where work is supervised by the Department of the Navy and carried on by civilian contractors from the states. Drilling operations are under contract to the Arctic Contractors, Inc., the C. F. Lytle Company, and Green Construction Company, while United Geophysical Company carries on the seismograph work and the U. S. Geological Survey does the geological surveying.

The accompanying map indicates the various areas of activity in the reserve according to the latest information available.



The Imperial Sarnia, largest tanker ever built in Canada.

Canada To Launch Largest Fresh Water Tankers

TWO oil tankers, part of a modern transportation system which next year will carry crude oil from the Alberta fields to Ontario refineries, will be launched this month in Port Arthur and Collingwood, Canada.

The Interprovincial pipe line, described in the August issue of WORLD OIL, will transport oil 1150 miles from the fields near Edmonton to Lake Superior. From there the giant, 5000-ton tankers will carry it to refineries in Ontario at a rate of about 5 million barrels a year.

While shipyard workers were swarming over the growing hulls of the tankers, pipe line crews were laying an average of nine miles of pipe a day in a race to have the line underground before winter. The first crude oil entered the pipe line August 25 at Redwater and was moved 30 miles to the Edmonton storage tanks where it will be on hand for the main line.

To be christened the Imperial Redwater and the Imperial Leduc, the launching of the two tankers in itself will be a major undertaking. Coming down the ways, the ships, each of which is 620 feet long and 68 feet wide, will enter docks only 713 feet long and 98 feet wide.

As launching is one of the highlights in a ship's life, the men in the shipyards are taking every precaution to make the ships first dip into water a success. With the docks only 30 feet wider than the ships, 5000 tons of steel pick up a tremendous momentum as the hull slides down the ways and falls with a mighty splash into the water. The wave thrown up by the ship in launching could cause great destruction in the shipyard if special precautions were not taken. Buildings within the range of the water will be barricaded and anything that might be moved by the splash will be taken out of the way. The 5000 tons of water displaced by 5000 tons of steel is a force to be reckoned with.

The two ships will be the largest fresh water tankers in the world. After the launching they will be fitted out during the winter to be ready for service when navigation opens next spring. Despite their great size, no special construction problems have arisen. The empty hulls will be fitted with engines and boilers and the most modern fire-fighting equipment. For navigational purposes, the captain will have at his disposal the latest developments in radar, ship-to-shore telephone and radio direction finders. A gyrocompass will give him his heading and a fathometer will record the depth of the water through which the ship is passing. The crews have unusually comfortable quarters and there is a recreation room for officers and men. The ships were built by Pipe Line Tankers, Ltd., and will be chartered by Imperial Oil Company, Ltd.

New Pipe Line, Tankers Move Pemex Petroleum

Mexico's oil and gas transportation problem was eased with the dual announcement by Petroleos Mexicanos that work had started on the new Monterrey-Torreon gas pipe line, and that the Mexican government had purchased six new tankers.

The pipe line will extend natural gas supplies to the cotton-growing center of Torreon. The additional tankers will be used both for international service and for coast-wise distribution between Mexican ports.

Acquisition of the new tankers increases Pemex's fleet capacity by 400,000 barrels. Five of the tankers were built in the U. S., and the sixth was bought in Spain, according to Senator Antonio J. Bermudez, director general of Pemex.

ECA Ruling Brings Foreign Price Structure to Brink of Collapse

By HENRY OZANNE
Eastern District Editor

THE Economic Cooperation Administration has made good its long-standing threat to order reduction in petroleum product prices for shipments from the Middle East to Western Europe. As a result of the agency's recent ruling the whole foreign oil price structure is on the edge of collapse, the most notable result of which may be to establish Gibraltar as the dividing line between the "competitive watersheds" of the Persian Gulf and the Caribbean refining areas.

The cutback order was scheduled to go into effect September 15, but protests by the oil companies involved resulted in a postponement until October 1.

ECA, after months of inaction, announced that "a price for a petroleum product purchase from sources other than the U. S. will be eligible for ECA financing if it does not exceed the lowest competitive market price in the U. S. with the following qualifications:

"F.O.B. Middle East prices for petroleum products may not exceed U. S. prices less $3.50 per long ton for loadings from Arabian ports or Bahrein Island; $4 a ton for loadings from Kuwait; or $4.20 per ton from Iranian ports on all shipments except those to Northwest Europe, the United Kingdom and Scandinavia. On shipments to the latter destinations prices will be somewhat lower to conform with historical industry practice."

California-Texas Oil Company immediately served notice on ECA that the new regulation will prevent the company from supplying any oil products to Marshall Plan countries. W. H. Pinckard, Caltex Board chairman, told ECA Administrator Hoffman that the ruling was unfair and discriminates against Caltex in the Middle East.

Pinckard said: "Caltex' view is that it seems unfair to have a regulation issued which is designed to force an arbitrary reduction in the price of Caltex petroleum produced in the Middle East to a point below competitive prices when the same regulation does not apply to companies in the United States where the investment is relatively safe. Such government policies can only result in discouraging American industry, enterprise and investment abroad."

Following criticism of its action, ECA announced to Western European governments that several countries were being charged high and discriminatory prices for products purchased from American-controlled companies in the Middle East. ECA defended its own action, saying:

"The amendment substantially eliminates the discrimination existing between the lower F.O.B. prices charged on shipments to Northwest Europe, United Kingdom and Scandinavian points and the prices charged F.O.B. Middle East on shipments to other countries.

"For example, prior to the amendment, Arabian and Bahrein suppliers charged F.O.B. prices (equivalent to the U. S. market price) on shipments to Greece and Turkey and they charged (the market), reduced by amounts ranging from $4.35 to $4.85 per long ton on shipments to 'the most distant countries.'"

ECA's order froze these existing reductions off the market price to all customers historically enjoying them, that is, to 'the most distant countries,' and the companies are ordered to grant nearly as large reductions to all other European customers buying with ECA dollars.

Harvey Daniels, former Socony-Vacuum Oil Company official, is taking the post of chief of ECA's petroleum branch in Washington, succeeding Dr. Oscar Bramsky, who will head the ECA office in Paris.

ECA and Caltex Dispute Sale of Oil to China

The Economic Cooperation Administration has asked refunds of $1,135,117.71 from California Texas Oil Company because of alleged high prices charged on sales financed by ECA to subsidiary and independent purchasers in China. W. H. Pinckard, Caltex board chairman, replied that ECA had sent the company lists of former shipments made in Nationalist China on which ECA claims the overcharges were made and that the company had begun discussions with ECA to determine the facts.

Pinckard said Caltex has endeavored to comply fully with all ECA regulations. In the case of the China shipments, Caltex prices were charged in accordance with existing contractual commitments and were as low as competitive prices.

ECA makes two basic charges. The first is that ECA regulations were violated because the price charged by Caltex was allegedly greater than the delivered price of oil from the West Coast of the U. S. This charge presupposes that the West Coast of the U. S. was at that time the normal and available U. S. supply source for shipments to the Far East, which was not in fact the case.

Brazil's Amazon Basin To Get First Deep Test

First deep test for the Amazon Basin of Brazil has been located at Limoeiro, on the west bank of the Tocantins River near its mouth and approximately 120 kilometers (about 75 miles) southwest of the city of Belem, Para.

The well is being drilled for Conselho Nacional de Petroleo (National Petroleum Board), the official petroleum agency of the Brazilian government. Preliminary geological and geophysical studies were initiated during the latter part of 1946.

Studies revealed the presence of sedimentary beds believed to be more than 10,000 feet thick. These beds underlie the west half of Marajo Island and extended southward under the lower valleys of the Tocantins, Moju, Acara, and Capim rivers. The beds are profoundly faulted in a north-south direction, with the principal fault extending from the valley of the Rio Capim north across Marajo Island. Well site is on a prominent anticline.

To drill the well the National Petroleum Board has acquired a U. S.-made rotary rig with a 150-foot derrick, powered by a 1500-horsepower diesel engine and capable of drilling to 14,500 feet. Schedule calls for 12,000 feet of hole in six months.

Trade Agreement Set

A trade agreement between Western Germany and Colombia, scheduled for early ratification, provided for about $3 million worth of crude imports for Colombia during the fiscal year 1950-51. The imports consist of royalty crude due the Colombian government.

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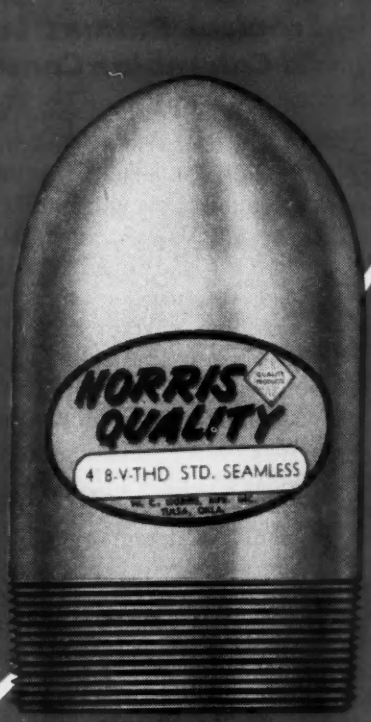

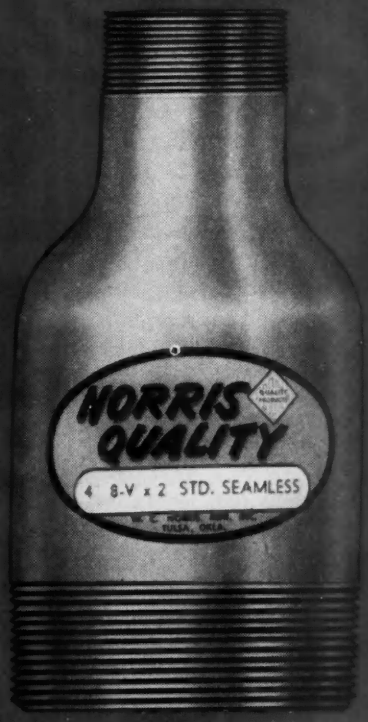

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Saskatchewan Has Discovery In New West-Central Area

OIL of apparently good commercial quantity has been discovered in an entirely new oil area of Saskatchewan, according to the government Department of Resources. The new discovery, Heart's Hill 1, drilled by Albercan Oil Corporation, is located at a point midway between the towns of Major and Heart's Hill in west-central Saskatchewan, and is 90 miles southeast of Lloydminster. The nearest oil production is the Dina-Marsden field on the Alberta-Saskatchewan border 60 miles northwest.

Albercan, a subsidiary of Pancoastal Oil Company C. A. of Venezuela, is one of the scores of oil companies which have been actively engaged in oil exploration work in the province during the past 21 months. This company's Heart's Hill discovery marks the first important find in the current search. Most of the exploratory work in the province has been along the Alberta border where operators feel extensions of the Lloydminster, Dulwich, Lone Rock and Dina-Marsden fields will be found. Husky Oil and Refining Company, Ltd., has been drilling 10 to 20 miles east of Lloydminster, with three oil wells reportedly finding oil; and the Caldough Oil Company reported four oil producers 30 miles east of Lloydminster. However, the Albercan well represents the longest stepout from established production.

The new well was drilled on the basis of data obtained from a gravity meter survey. Drilled to a total depth of 3100 feet, the well had several encouraging oil shows up the hole. The hole was plugged back to 2678 feet and casing was set down to the plug. Although the depth of the producing zone is not given, the well had 1400 feet of oil standing in the hole and a pumping unit was moved onto the well site. The well was put on steady production about September 1. Initial production tests on Heart's Hill 1 were carried on for about a month with a bailer, but this method was too inaccurate to permit an estimate of the well's potential. At a bailing rate of 35 barrels a day the 1400 foot oil column was not lowered, so the well will probably pump at a greater rate than this.

On the basis of gravity meter information the section penetrated by the discovery well covers about 3200 acres. If future drilling encounters production as good or better than Heart's Hill 1, an active field encompassing about five square miles will result.

Production comes from an unbroken sand section 42 feet thick in the lower Cretaceous series. The section is the thickest oil bearing strata yet found in the province. The oil itself is a heavy crude similar to that found in the Lloydminster field, but Albercan officials expect to find lighter oil 75 to 125 feet updip in the same formation. This would seem to be an unlikely possibility, but the fact remains that the market for heavy crude has improved in Canada in recent months and prices have advanced considerably. The black oil and its byproducts are used as bunker C fuels for power plants, bunker C and diesel fuels for locomotives and tractors, domestic fuel oils and as an important ingredient in road surfacing material. The demand for these products in Canada has probably been fairly constant, but the lack of adequate transportation facilities substantially stifled the market. These conditions are rapidly being remedied.

Albercan now holds 2,008,437 acres of land under permit in Saskatchewan, 250,000 acres of which are surrounding its Heart's Hill 1. The company recently spudded its fifth well in Saskatchewan for the year. Plans call for 12 wells to be drilled in the province during 1950. The Heart's Hill well was the company's first drilling operation in Canada, but it was soon followed by test wells near Kerrobert, Richard and Hafford to the east. At Kerrobert, 20 miles east of Heart's Hill 1, Albercan reported all the geological requisites for a prolific oil field, but no oil. The company's fifth well is being drilled in the Mayfair area and is planned as a deep test, probably to the top of the Precambrian.

Egypt Restricts Tanker Movements Through Suez

The American Merchant Marine Institute in New York has protested a new Egyptian customs ruling requiring captains of northbound tankers passing through the Suez Canal to sign declarations that their vessels will proceed directly to specified ports of destination after leaving Port Said. The order apparently was drafted to prevent tanker delivery of crude oil to Israeli ports, especially Haifa.

The new Egyptian order also provides that tanker masters must sign with customs officials at the port of destination statements that their cargo was discharged there and for local consumption only. This statement must be countersigned by the Egyptian consul.

The AMMI's tanker committee, which lodged protest at the new order, contends that the regulation exceeds the Suez Canal Convention and constitutes an undue interference with international trade. Further, says the protest, the tanker's captain is unable to say that his discharged cargo is for local consumption only because the master does not control its ultimate disposition.

The Egyptian government warned tanker operators that force would be used to prevent tankers from reaching Israeli ports.

Tropical Retains Lease Of Colombian Concession

Tropical Oil Company has been granted a new lease covering its former Balsamo concession in the Department of Magdalena, Colombia. Some industry observers believe this action by Colombia indicates a change of heart on the part of the Colombian government which had been moving in the direction of a full state oil monopoly. However, a recent economic mission to Colombia had urged the advantages of free private enterprise there, and difficulty already had been encountered from Colombian nationals who refused to finance a government-controlled company. As a result, the government decided to yield 55 percent control of its new agency to private interests.

Tropical, a subsidiary of International Petroleum Company, an affiliate of Standard Oil Company (N. J.), announced last year that it would relinquish the De Mares concession at the expiration date, August, 1951, and it was generally believed that the Balsamo concession also would be surrendered. Under the new grant, however, Tropical will continue as the only remaining foreign-owned producing and distributing company in Colombia under "a very important contract."

Baker "Universal Type" Packer

constant pulsation is present. SUCCESSFUL UNDER HIGH BOTTOM-HOLE TEMPERATURES — The oil-resistant Hycar packing element, combined with lead retaining seals, has proved in countless wells to be effective against high temperatures. IT IS CORROSION RESISTANT . . . with cast iron construction that is far more resistant to corrosion than the steel casing in which the Packer is set. THE TUBING IS FREE FROM THE PACKER . . . which permits unrestricted running and pulling of tubing and rods. No SET-DOWN WEIGHT IS REQUIRED — When it is desirable, the tubing can be suspended in tension to permit dropping pressure bombs (and other devices) through the tubing. You are not handicapped by "corkscrewed" tubing often resulting when set-down weight is applied to conventional type packers. WORK CAN BE DONE THROUGH THE PACKER — Gun perforators, suction bailers, acid jet guns and other devices may be run through the Packer and past the Flapper Valve for any necessary operations below the Packer; and the tubing can always be run back through the Packer after such work is completed. The well can be plugged back with cement to a new bottom through the Packer. The Packer can be converted to a casing bridge plug, or cementing operations can be performed through the Packer as though a cement retainer were being used. IT IS COMPLETELY DRILLABLE — Because the major parts of this packer are made of cast iron, you will never have to "mill up" a Baker Retainer Production Packer.

Specific Recommendations Available

If you have any production problems which might be solved by the use of a Baker Model "D" Retainer Production Packer, we suggest that you contact the nearest Baker representative who will gladly furnish helpful recommendations. Send for your copy of the new brochure with many installation drawings; or see the Baker (and Composite) Catalog.

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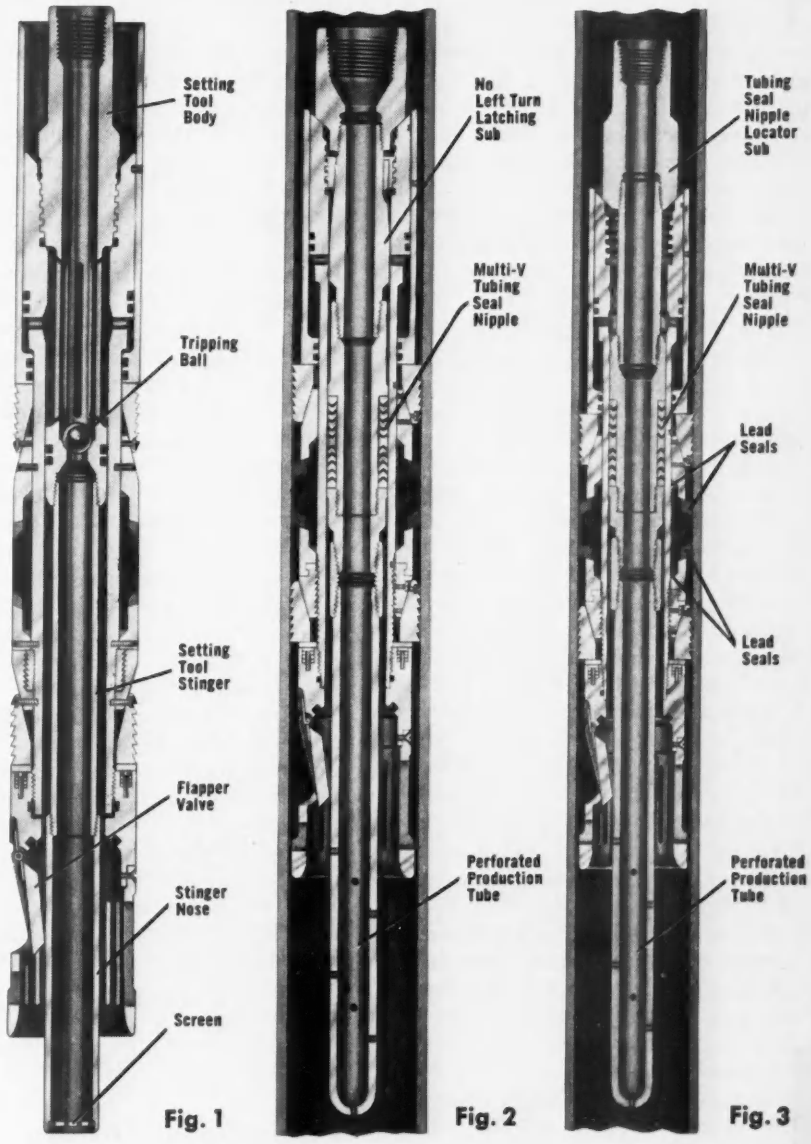

FIG. 1.—Setting Tool for Baker Retainer Production Packer, equipped with Stinger Nose to hold the Flapper Valve open while running-in the well. After the Packer is set the Setting Tool is removed from the hole, followed by selection and use of accessory equipment as indicated. FIG. 2.—When it is desirable to suspend the tubing in tension in a single or dual-zone completion hook-up using one packer, the No Left Turn Latching Sub is employed. This unit does not effect a seal when seated, but provides definite assurance that the Multi-V Tubing Seal Nipple is properly positioned in the bore of the Packer and will not be moved up or down by contraction or expansion of the tubing. FIG. 3.—When it is desirable to apply "set-down" weight of the tubing string, the Tubing Seal Nipple Locator Sub serves as a locator (or marker) to assure proper positioning, and to prevent downward movement of the Tubing Seal Nipple.

In addition to conventional setting on tubing or drill pipe, WIRE LINE SETTING of the Baker Retainer Production Packer is available through several leading service organizations. Any Baker office or representative will furnish complete information.

Egypt Plans New Oil Laws To Appease Foreign Firms

THE Egyptian Parliament is expected to approve new petroleum legislation this year in a final effort to persuade foreign oil companies to continue operations in that country. For two years a political deadlock has paralyzed Egypt's oil exploration program, and all foreign companies are now ready to quit unless more attractive government terms are forthcoming.

The situation is critical for Egypt in view of the hope it is placing in oil for a rehabilitation of the Egyptian national economy. Geological reports are favorable for several areas in Egypt, both on the Sinai Peninsula and in the Western Desert, but the two principal American operators, Standard Oil Company (N.J.) and Socony-Vacuum Oil Company are unwilling to maintain their programs unless a new law is enacted. Jersey Standard already has suspended work and it is understood Socony-Vacuum is prepared to give legal notice of abandonment. The third big foreign operator, Anglo-Egyptian Oilfields, Ltd. (Shell) is also ready to quit, as is the French company, Societe Generale des Huiles et de Petrole.

In an effort to prevent withdrawal of foreign firms, the Egyptian government recently offered new prospecting licenses to the American, British and French companies, but all the foreign interests have rejected the offer. One American company observer described the pending offer as "nothing but a device by which Egypt can replace her decree law for another equally impossible."

Since none of the foreign companies had accepted the new offer at the time the Egyptian Parliament adjourned last month, the government is understood to be ready to submit a new bill to Parliament on its re-convention in November. This date may be the decisive time in Egypt's oil history—marking the end of the participation of outside capital and skills that have developed the Egyptian petroleum industry to date, or the beginning of a new period of possible cooperation between Egypt and the foreign operators.

Currently Egypt refuses to grant concessions to any foreign oil company unless 51 percent of the company stock is held by Egyptian citizens. Egypt also demands a stiff royalty rate and sizable quantities of oil produced at below market prices. Egyptian Commerce Minister Mohammed Soliman Channam Bey has threatened to seize all producing wells, those of Socony-Vacuum and Shell, along the Red Sea.

Egypt's present crude output is about 40,000 barrels daily, but that quantity will be cut with Shell's declared intention to suspend operation of the Ras Materma wells south of Suez. A wholly-owned Egyptian company, Egyptian National Petroleum Company, has been formed to explore for further oil sources, but the company is not in a technological position to handle any adequate exploration program.

Negotiators who have followed the situation say Egypt is basing its nationalistic position on the hope that the U. S. Gulf Coast pricing structure is about to collapse because of the increasing volumes of Middle East oil moving to the Eastern Mediterranean and from there to Western Europe. A new crude oil basing point for world prices is emerging, many economists believe, in the Eastern Hemisphere, and if established, that price "watershed" could become the Suez Canal area. Egypt, close to the Middle East fields and at the terminal of the trans-Arabian and Iraq pipe lines, would then be able to capitalize on the new low-cost production, low-transportation factors of the Middle East.

Venezuela's Production Declines During July

In comparison with the record high daily production of 1,586,866 barrels for the week ending June 26, crude oil production in Venezuela dropped to 1,520,599 barrels daily for the week ending July 17. This production is well above the daily average for 1949 of 1,252,000 barrels, however. This latest production figure is broken down by companies and sections of the country in Table 1.

Mene Grande Oil Company drilled ten exploratory wells during July which resulted in the discovery of one new field, the Tagua 1, and eight new pool discoveries within established fields. The new pool discoveries were in the Leona, Oficina, Nipa, Guara and Mapiri fields in Eastern Venezuela, and one in Lake Maracaibo. The latter, Rod 517, found Eocene production of about 400 barrels a day.

Wildcat commencements in July included Mene Grande's Cerro Pelado 1, 5 five miles west of the La Ceiba production. Sinclair Oil Company spudded Guere 1, four miles from Mene Grande's new Los Mangos field in Anzoategui. Shell Oil Company suspended drilling operations on its DMC 1, five miles from the Mara field, and the Atlantic Refining Company temporarily halted Guama 1 in northwest Guarico state because of surface floods and a rig fire. Socony-Vacuum Oil Company abandoned its Silvan 2 in the remote Barinas area after reaching 10,804 feet. No further drilling activity will be carried on there by the company at present although geophysical prospecting will continue. The same company completed its Chimire 37R, in Anzoategui, as a dual producer. The Texas Company's Mata 1, twelve miles from the Nipa field, stuck pipe on bottom at 11,439 feet in mid-July and was still fishing in August. Richmond Exploration Company suspended drilling operations entirely for the present, following the failure of its Zulia 1C-1 to find deep limestone production on the west side of Lake Maracaibo.

Surface exploration parties in Venezuela totaled 30 in July, continuing to drop in number as the rainy season advanced. Nine geological and geophysical parties worked in the state of Zulia, six parties operated in the eastern state of Anzoategui and five in the state of Falcon, northeast of the Bolivar coastal fields. The other ten parties were scattered throughout the other five states.

Creole, Shell, Richmond and Mene Grande have jointly contracted the Marine Geophysical Company of Dallas to conduct a six-month seismic survey of underwater concessions in Lake Maracaibo.

TABLE 1

COMPANY	Western Venezuela	Eastern Venezuela	Daily Total
British Controlled Oil Fields	991	.....	991
Creole Petroleum Co.	492,463	130,250	622,713
Mene Grande Oil Co.	65,200	204,210	269,410
Pantepec Petroleum Co.	.....	13,213	13,213
Phillips Petroleum Co.	.....	7,930	7,930
Richmond Explo. Co.	18,555	.....	18,555
Shell Oil Company	468,065	.....	468,065
Sinclair Oil Company	.....	12,858	12,858
Socony-Vacuum Oil Co.	.....	37,653	37,653
Texas-Mercedes Pet. Co.	18,488	29,382	47,870
Venezuelan Atlantic Refining	99	21,242	21,341
Total Daily Average	1,063,861	456,738	1,520,599

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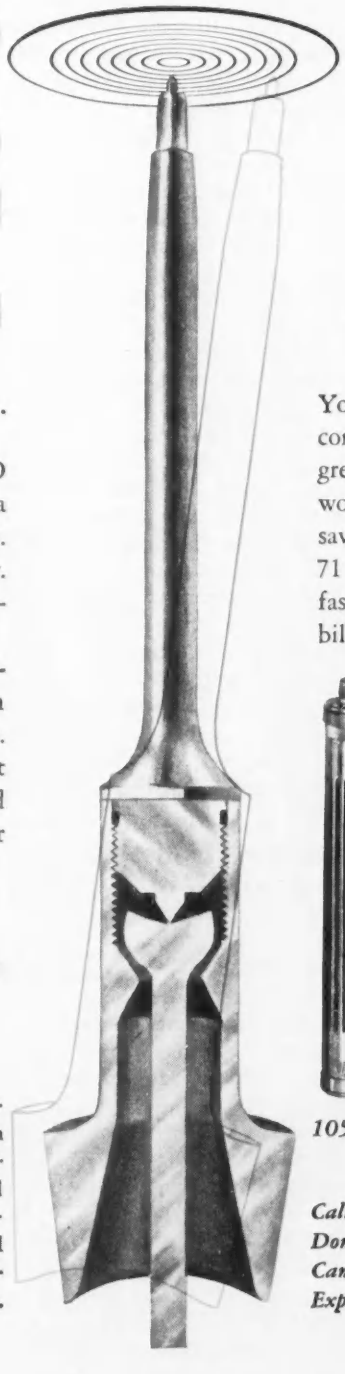

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Danish American Firm Contracts For New Concession in Denmark

DANISH American Prospecting Company, wholly owned subsidiary of U. S. Gulf Refining Company, has recently signed a new concession contract covering the Kingdom of Denmark, exclusive of Greenland and the Farol Islands, on the basis of which its drilling operations in that country, will be increased. The concession covers 17,000 square miles of land area plus the adjacent water areas.

The new concession is for 50 years with an initial ten-year exploratory period extending from June 2, 1950, during which decade Gulf must make a discovery to continue the agreement. However, the contract includes three categories of subsurface substances for which exclusive rights are given the company: (1) all hydrocarbons; (2) saline substances from saltdomes, such as sodium, calcium, magnesium, potassium salts and gypsum; (3) helium. Gas occurring in glacial drift is not included in the concession. If a commercial discovery is made in the ten-year exploratory period, and it is put in production, the company will have exclusive exploitation rights for the substances of the particular category. DAPCO cannot suspend exploration activities for any period longer than two years. A flat royalty rate of 7½ percent is payable on the value of all hydrocarbons produced and sold, but on recovery of exploration costs this rate is to be increased to 10 percent. A sliding royalty scale is provided for saline substances produced, averaging about 7 percent of market value. Production operations must be conducted through a Danish subsidiary in which the Danish state will hold a 5 percent stock interest and the board of directors of which must continue one appointee of the Danish Crown.

The company will have the right to export its produced materials, subject to legislation, up to one-half the annual production of a given material.

Since the signing of the concession contract, Danish American has drilled one dry hole to basement rocks at a depth of 4317 feet in North Jutland on the edge of the town of Frederikshavn. During the last three years about 110 structure holes have been drilled. Through 1951, the company plans to keep three rigs at work, one of which is capable at least of 10,000-foot depths. Also the company is preparing to deepen its Gassum 1 well which for some time has been suspended at 9955 feet.

Early in 1948 Danish American abandoned at 8000 feet its first post-war deep test in the Vinding locality of West Central Jutland. In that same year the Danish government raised the question of the validity of the existing concession contract, but praised the company for its "efficient work conducted in good faith." The new concession just signed replaces the former one.

The concession history in Denmark goes back to 1935 when an F. F. Ravlin interest drilled two holes, the second of which discovered salt deposits. Ravlin then controlled Danish American Prospecting Company which won an exclusive concession in Denmark in 1938. Gulf Refining Company that same year bought the Ravlin interests and Danish American became a Gulf affiliate.

Prior to World War II the Germans made an oil discovery south of the Danish border at Heide, in Schleswig-Holstein, and the Danes developed the glacial overburden in a small field in Northern Jutland.

Danish American returned to Denmark in 1946 and resumed the exploration work which had been suspended in early 1940 by reason of the German invasion. Seismographic and gravitymeter crews were used and a second deep test was started at Randers, east central Jutland.

Venezuela Trade Mission On Buying Tour of U. S.

A VENEZUELAN trade mission, the only one of 48 foreign trade missions that has come to buy from the U. S. rather than sell to it, arrived in this country to attend the International Trade Fair in Chicago. Following the Fair visit the Venezuelan trade mission will tour the U. S. on an extensive buying trip for their government.

Ruben Nevado, director of the Ministry for Development of Venezuela and chairman of the mission, which consists of top leaders of industry, agriculture and petroleum of that country, emphasized that Venezuela was the only country of the 48 represented at the International Trade Fair that is here to buy services and products rather than to sell.

Nevado said that without any assistance from the Marshall Plan, Venezuela is the largest customer of the U. S. in Latin America and the second largest customer in the world. It is first in imports from the U. S. of eggs, dried milk, butter, processed cheeses, light trucks, cotton and silk clothing, food cereals, incandescent lighting fixtures, millwork, 11 types of steel building materials and 200 additional products.

Nevado also said that the two-way trade between Venezuela and the U. S. last year exceeded $1 billion, and Venezuela purchased far more from the U. S. than it sold to them. Nevado estimated that the U. S. favorable trade balance with Venezuela is more than $130 million a year. He emphasized that Venezuela can keep on buying from the U. S. only as long as this country continues to buy Venezuela's main product—oil. Excessive taxation of Venezuelan oil imports would oblige that country to curtail her purchases, thus sharply reducing in turn the sale of many million dollars' worth of American goods abroad.

In the latter statement, Nevado had reference to the return of import quotas to the terms of the Venezuelan agrement of 1939 which will become effective in the U. S. on December 31. With the return of these quotas, the present total import tax of 10½ cents per barrel will only apply to receipts up to 5 percent of the previous year's throughput of U. S. refineries and imports in excess of this amount will be taxed at the rate of 21 cents per barrel. This tax would probably have a decided effect on the Venezuelan oil industry as that country has been gradually losing some of its European markets to Middle East oil.

Members of the Venezuelan trade mission touring this country are Nevado, chairman; Gustavo Zingg, Jr., representing the Caracas Chamber of Commerce; Dr. Eduardo A. Acosta, advisor to the Venezuelan government on petroleum affairs; Rafael Omana, representing the Caracas Chamber of Industrialists; Celestino Diaz, representing the wholesale merchants of Venezuela; John P. Lee, representing the U. S. oil industry in Venezuela; Humberto Perez, secretary of the mission; and Hipolita Acosta, manager of the mission. Accompanied by Antonio Davila-Delgado, consul general of Venezuela in New York City, the group's itinerary includes Los Angeles, St. Paul, Minneapolis, Pittsburgh and New York.

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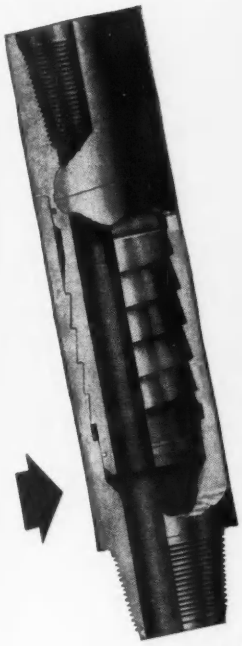

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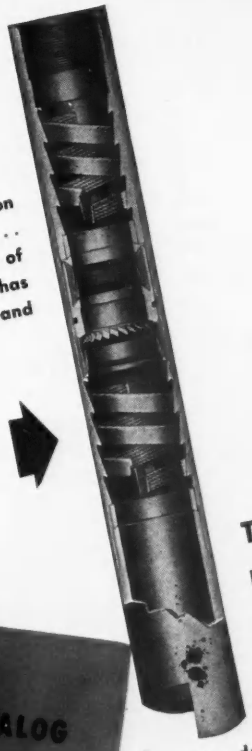

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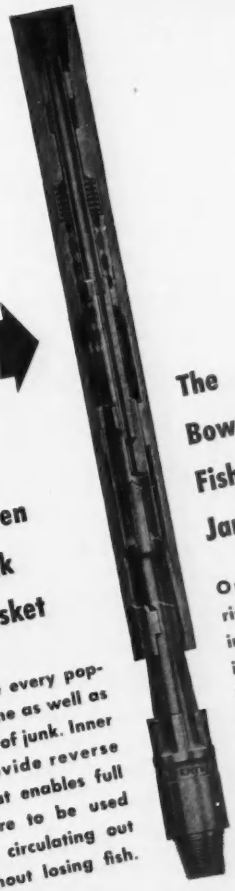

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Germany's Oil Occupies Vital Position in Western Europe

GERMANY annually produces about 6 million barrels of oil—all from the non-Communist area. While this is a small figure compared to some of the major oil producing countries of the world, it is the highest production of any of the European countries outside of the Iron Curtain. Because of this, any new developments in the German oil industry are important to those Western Union nations contemplating pooling their resources.

Seven new oil fields were discovered in Germany during 1949 which substantially boosted the countries reserves. One of these discoveries was the Eldingen field, 11 miles northeast of Celle, which was first drilled in December. Recent reports indicate that the discovery well went to salt water after the first of the year and it was feared that reserve figures would have to be revised downward. However, the operators, Gewerkschaft Elwerath, drilled a directional hole out of the original location and found oil at 5200 feet, about 30 feet updip from the oil-water contact. The new well tested 114 barrels a day through a 5/64-inch choke—with no water. The Eldingen 3 well, about 1 mile northwest of first well, found oil at about the same depth but will probably not produce as much as the deviated hole. The Eldingen field and the newly discovered Suderbruck field are apparently faulted anticlinal structures while the other fields in Hanover have all been based on salt domes. Because of this, the development of the former two pools will be more difficult until the structures are outlined.

Between Hanover and the Emsland fields on the Dutch border, a new field discovery has been made near Quakenbrueck by Gewerkschaft and Deutsche Vacuum Oel AG. The second well drilled in the area found production at 1900 feet and tested 284 barrels per day through a 14/64-inch choke. The high paraffin base crude comes from the Lower Wealden (Cretaceous) sand, and this field is the first new oil strike in Germany this year.

German oil operators had set a drilling goal for 1950 of 1,564,942 feet. The total footage drilled in 1949 was 864,351 and the new goal indicates the aggressiveness of the oil industry in Western Germany. During March of this year a total of 125,655 feet was drilled—if this rate continues, the goal will be surpassed. The increase in footage was credited to the use of more modern drilling rigs which substantially cut down time on location and moving to new drilling sites.

As was predicted earlier this year, offshore drilling got underway in May about 1½ miles from the shore near Cuxhaven. The well is near the mouth of the Elbe River in the North Sea. The Cuxhaven concession is jointly held by Preussag, Deutsche Erdoel AG and Deutsche Vacuum Oel AG but the actual drilling operations are being carried on by Deutsche Erdoel AG for the group. To permit continuous operations without interruption from tide or wave action, the derrick floor is built 23 feet above the low tide mark. Rig-to-shore telephones have been installed and radio communications will also be used shortly. Motor launches are used for transportation of personnel and materials from a landing stage on shore. Additional drilling will be undertaken in the area from 1½ to 3 miles from the beach.

During March Germany produced 634,243 barrels of oil. This is the highest monthly figure yet recorded for the country, and if the trend continues, the annual output should be in excess of 7 million barrels this year. Output from the Emsland fields has almost doubled for the comparable period of 1949 and the Hanover and Schleswig-Holstein fields have increased their yields markedly. April production in Germany was 629,785 barrels, which represents a daily increase of 530 barrels over the March figure. Forty-six percent of the production came from the Emsland fields and 43 percent came from the Hanover fields.

Foreign Firms Issued Invitation by Pakistan

The counsel general of Pakistan, in New York, announced that foreign oil operators will be welcomed to participate in the search for oil in his country. The government has decided that exploration for oil in Pakistan and, consequently, purchase of relevant equipment, will be left in the hands of private enterprise and will not be undertaken as a state responsibility. The consul general indicated that experienced American oil operators would be most welcome to take part in the search — "which in the opinion of geologists would be fruitful." These operators were assured that all necessary and reasonable facilities will be provided within the framework of existing laws and regulations.

Any person or group of persons, Pakistani or non-Pakistani, interested in the exploration of the oil resources of Pakistan, may apply to the Ministry of Industries, Government of Pakistan, Chief Court Building, Karachi, Pakistan, for an oil exploration license or an oil prospecting license covering the areas in which he is interested. If prospecting operations are successful, the licensee has the right to obtain an oil mining lease for a period of 30 years.

The government of Pakistan has recently granted an oil mining lease to Pakistan Petroleum, Ltd. (formerly Burmah Oil Company) covering the Patharia Forest area — a small section of about 10.2 square miles in the Sylhet District of East Bengal. This effectively ties up this particular region but American companies may still apply for oil exploration licenses for other areas of Eastern Pakistan, in accordance with the conditions governing the grant of concessions as laid down in the Pakistan Petroleum Production Rules of 1949.

In Western Pakistan, the Attock Oil Company holds oil mining leases over the Khaur, Dhulian and Balkassar areas, while the Burmah Oil Company has been granted a mining lease covering about 54 square miles in the Chakwal District of the Punjab, where they have been prospecting. The rest of the area of Western Pakistan is open to application for mining concessions under the same conditions of Eastern Pakistan.

The consul general stated that several applications are now before the government and many more are anticipated.

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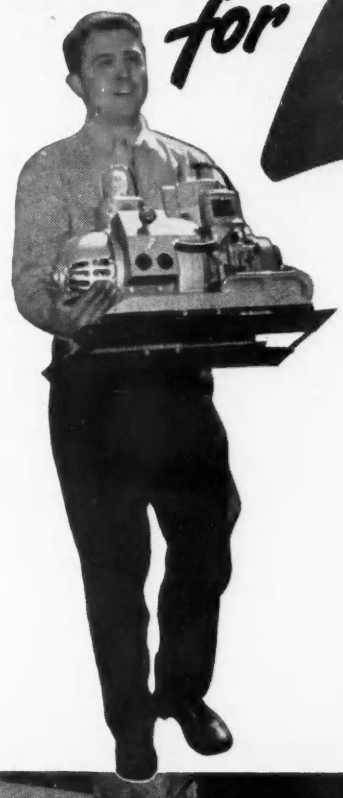

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Talks With British Open Way for Aramco to Make Use of Sterling

NEGOTIATIONS between the British government and the Arabian American Oil Company have opened the way for Aramco to utilize sterling in some of its overseas transactions. Companies which market Aramco oil are arranging to pay Aramco in sterling and other currencies. The talks with the British were for the purpose of adjusting exchange restrictions so that sterling received from the marketing companies could be used by Aramco for purchase of materials needed in Saudi Arabia and in royalty payments to the Saudi Arabian government.

As a result of these talks in London, Aramco expects its production in Saudi Arabia to average about 490,000 barrels a day for the year 1950, an output considerably higher than originally estimated, as the utilization of sterling will enable the company to retain markets which otherwise might have been lost.

Aramco is stressing the program of its Arab Industrial Development department for the promotion of the welfare of Saudi Arabia. Through this department the company has let more than 331 contracts to Saudi Arabs, thereby allowing many former employes to establish their own businesses. Contracts let to Saudi Arabs during 1949 totalled about $4 million and included such varied work as:

Construction of many types of buildings, walls, tanks, slabs, piers; railroad construction and track maintenance, installation of sewers, water lines, electricity and plumbing; all kinds of excavation; pipe line installation and maintenance; handling and transporting materials; rock quarry operations; camp cleanup and sanitation; gardening and landscaping; manufacturing bricks and blocks; operation of garages, grease racks and wash racks; tire repair; operation of dump trucks and personnel carriers; servicing airplanes; water well drilling; painting, fence building; marine repairs, tent making; operation of camp facilities for seismographic and gravity meter parties.

Aramco designed and started its 5-year industrial training program for Saudi Arabs in 1949. This program calls for on-the-job training of more than 8000 Saudi Arab employes who are now unskilled, and special training programs have been launched for the semi-skilled employes. From about 1800 such employes the best qualified will be selected for advanced trade training to develop administrative and supervisory skills, as well as to perfect technical skills. Driving schools at Dhrahan and Ras Tanura now include automotive mechanical training and operation of all types of heavy construction equipment. A total of 853 employes passed the final examination given by the driving schools last year.

In its review of 1949 achievements, Aramco says that 2 new fields were discovered that year, one at Ain Haradh and another at Al Fadhili. A total of 24 wells were completed in Abqaiq, Damman, Dome Qatif, Ain Haradh, Ain Dar and Al Fadhili. Five wells were drilling at the end of the year.

Total 1949 production of oil was 22,820,783 tons (174,008,629 barrels as against 18,751,270 tons (142,852,989 barrels) for 1948.

Houston Nomads' visitors at the September meeting were, front row, left to right, M. Coyle, Troco, Colombia; C. G. MacDonald, Mexican-American Independent Company, and I. B. Allen, Peticon, Caracas, Venezuela. Back row, Ed Upton, general manager, F. H. Maloney Company; Don Meek, Mexican-American Independent; and Ray Kail, export manufacturers' representative.

Saudi Arabia Output for August Tops 18 Million

August crude production in Saudi Arabia amounted to 18,160,748 barrels, or an average of 585,831 barrels per calendar day, it was announced by Arabian American Oil Company.

Crude processed at the company's refinery at Ras Tanura amounted to 2,791,476 barrels, or an average of 90,048 barrels per calendar day. Crude production for the first eight months of 1950 amounted to 124,006,106 barrels, an average of 510,313 barrels per calendar day. Crude run in the refinery for the same period was 21,440,902 barrels, an average of 88,234 barrels per calendar day.

German Oil Men Request Improved Economic Setup

Economic protection of the German oil industry against cheaper and more plentiful foreign oil was the major consideration of a joint proposal for a new system of oil duties and prices, submitted to the Ministries of Finances and Economics at Bonn on behalf of the 16 leading German crude producing and refining companies.

Chief provisions of the proposal specified that German producers would receive for domestic crude prices comparable to those for imported oil. Refiners would pay a duty on foreign crude which would be levied on the dutiable finished products, rather than on the crude itself.

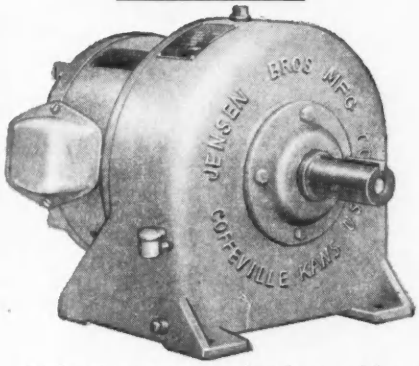
Financial interests of the producing industry are clearly separated from those of the refiners, under the new system. German producers, while they would no longer receive subsidies or compensation payments, would get tariff protection. A sliding scale of duties which has been in force several years would be replaced by a system of fixed levies, causing the price level of German petroleum products to adjust to fluctuations of the world market.

NEW AND IMPROVED EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

Speed Reducer

This item supplements Jensen Brothers Manufacturing Company data on pages 2549-2552 of Composite Catalog, 17th Edition.



A planetary gear speed reducer with an electric motor bolted directly to its frame makes a compact, easily-mounted unit that requires only slightly more space than the motor itself for installation. The frame is cast semi-steel, gears are machined and shaved, and main shaft is mounted on anti-friction bearings.

The unit, called the GEARTORK, considered especially adapted for replacement power for internal combustion engines on oil field pumping units, is available in a variety of sizes from ½ to 10 horsepower. The same sizes are available with double reduction gear trains. Flange mounted models have been developed for special applications.

For additional information write Jensen Brothers Manufacturing Company, Coffeyville, Kansas.

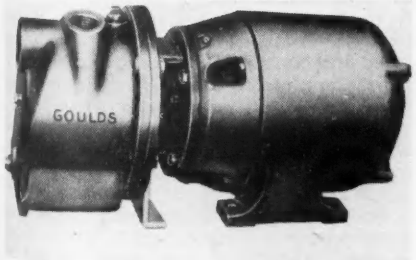
Self-Priming Pump

This item supplements Goulds Pumps data on pages 1846-1847 of Composite Catalog, 17th Edition.

All valves are eliminated from a new line of self-priming centrifugal pumps. Efficiencies of the pumps are comparable to standard centrifugal pumps. There is no large and bulky priming reservoir, and no recirculation of water during the pumping stage.

Pumps are available in sizes from ¼ to 5 horsepower with open and closed impellers, capacities to 120 gallons per minute, and heads to 135 feet depending on the capacity.

For additional information write Goulds Pumps, Inc., 75 Fall Street, Seneca Falls, N. Y.



Reamer

This item supplements Security Engineering Company data on pages 4389-4432 of Composite Catalog, 17th Edition.

A new reamer-stabilizer, when run between drill collars, eliminates drill string whip and vibration, thus increasing the over-all rig drilling efficiency.

Three angularly set barrel-shaped cutters act as a large roller bearing contacting more than one-third of the hole circumference, absorbing and transmitting to the formation all forces tending to start drill stem whip and rock bit gyration. Heavy ribbed sections between the cutters provide extra strength required for stabilizing duty and act as a guide for the return circulation, directing it past the cutters to keep them free from cuttings.

The reamer-stabilizer can be made up with a choice of three sets of cutters to produce the most effective stabilizing action in any formation.

For additional information write Security Engineering Company, Inc., 108 West Whittier Boulevard, Whittier, Calif.

Save Time—Write Direct

As a service to readers, all items in WORLD OIL include the complete mail address of the manufacturer. This makes it possible for those desiring additional information to write any manufacturer without the delay occasioned by going through offices of WORLD OIL, and enables subscribers to request specific data in which they are particularly interested.

Conversion Kit

This item supplements the Waukesha Motor Company data on pages 4914-4915 of Composite Catalog, 17th Edition.

Quick field changeovers from diesel fuel to natural gas or vice versa of Waukesha diesel engines Models 6-LRD and 6-WAKD can be effected by means of a new conversion kit.

So simple that it can be used by the operating or maintenance engineer on the job, the kit includes gas cylinder heads together with ignition and carburetion equipment; plugs, seals, and protective material for the diesel fuel injection equipment while not in use; new gaskets and hose connections; and boxes for moving and storing the engine parts.

Water-cooled exhaust manifolds with dual ignition, automatic top cylinder oiling, automatic safety shut-down ignition circuits, and gas carburetors developed for top performance are provided.

For additional information write Waukesha Motor Company, 1945 Jay-Vee Drive, Waukesha, Wis.

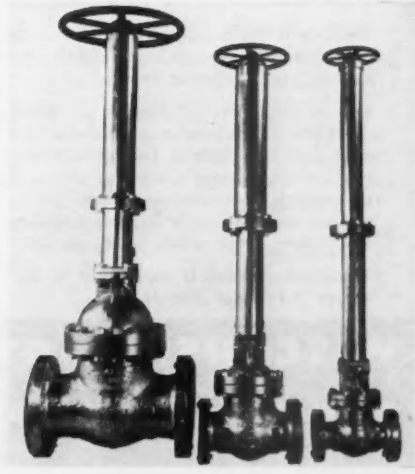
Floor Stand

This item supplements Kerotest Manufacturing Company data on pages 2613-2632 of Composite Catalog, 17th Edition.

An improved, all-steel floor stand arrangement for the operation of valves by means of stem extensions is made up of an extension and steel yoke which connect directly to the valve bonnet.

This arrangement is reported to assure greater rigidity for the stem extension, greater strength with less bulk, and dependable, easy operation of extended valve stems. All pipe line or industrial valves can be accommodated by the product.

For additional information write Kerotest Manufacturing Company, 2539 Liberty Avenue, Pittsburgh 22, Penn.



Bonding Kit

This item supplements Dresser Manufacturing Division data on pages 1382-1384 of Composite Catalog, 17th Edition.

Bonding mechanical couplings on steel pipe lines is simplified by the use of a new bonding kit, consisting of 50 preformed bonds, welders, flint gun, flash powder, metal discs, and coating compound for completing 50 bonds. The kit employs a five-second chemical welding method that can be used by any workman.

Among the properties of this method claimed by the manufacturers are low resistance of the bond, no danger of burning the copper wire, pipe, or inside pipe coating, no dangerous fumes, no heavy equipment to handle.

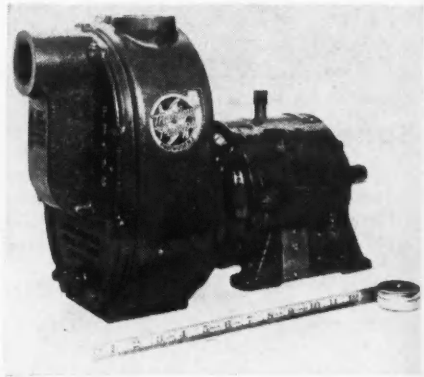
For additional information write Dresser Manufacturing Division, Dresser Industries, Inc., 818 Fisher Avenue, Bradford, Penn.

Centrifugal Pumps

This item supplements Marlow Pumps data on page 3081 of Composite Catalog, 17th Edition.

Two new self-priming centrifugal pumps, models 12HG and 14HG, will handle liquid hydrocarbons with viscosities up to 500 Saybolt seconds universal. They are intended for service where the required capacity does not exceed 50 gallons per minute, and they will operate at pressures up to 35 pounds per square inch.

The new pumps, supplied with 1½ x 1½-inch and 2 x 1½-inch female threaded suction and discharge connections, have aver-all dimensions of 17½ x 8½ x 12¼ inches. Required input speed is low since



the pumps are provided with a compact 1-5 ratio geared speed increaser.

A new self-lubricating shaft seal particularly valuable for handling gasoline and other dry liquid hydrocarbons has been used in these pumps.

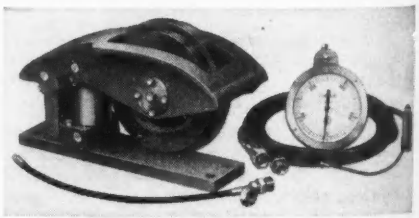
For additional information write Marlow Pumps, 568 Greenwood Avenue, Ridgewood, N. J.

Torque Gauge

This item supplements Martin-Decker Corporation data on pages 3089-3128 of Composite Catalog, 17th Edition.

A new torque gauge which instantaneously measures either the total torque or net-torque-on-bit at the driller's position operates on any type power. The manufacturer claims that it saves chain, increases footage on deep wells, increases footage when drilling with small bits, and is indispensable for milling, cutting jobs, and diamond coring. The gauge is remarkably sensitive, and can be installed and adjusted to any chain without difficulty. It is easy to read and easy to understand.

The assembly consists of a load-sensitive element—chain idler, load responsive cyl-

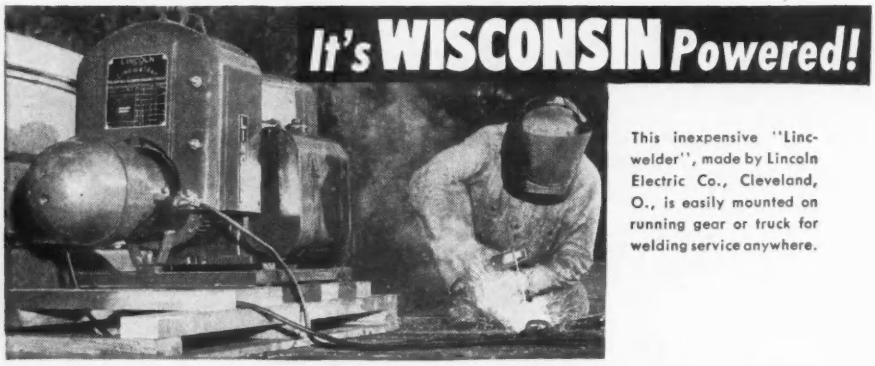


inder, high-pressure hose, damper and six-inch rotatable dial indicating gauge. The idler wheel is pushed by the tight side of the rotary chain—the push directly related to the torque in the drill pipe. The load-sensitive element, connected to the same lever arm as the idler wheel, builds up a hydraulic pressure which is used to actuate the dial gauge at the driller's position.

The Hydro-Mech indicating gauge can be installed as an individual unit or as an integral part of other Martin-Decker drilling controls. Recorder is optional.

For additional information write to Martin-Decker Corporation, Cherry Avenue and Wardlow, Long Beach 7, Calif.

FAST ON-THE-SPOT REPAIRS
With This Portable Welder!



This inexpensive "Lincwelder", made by Lincoln Electric Co., Cleveland, O., is easily mounted on running gear or truck for welding service anywhere.

Welding at the breakdown-scene . . . adds up to savings in time and labor with this light but rugged 180 amp. Lincoln Welder, powered by a two-cylinder Wisconsin Heavy-Duty Air-Cooled Engine.

The performance satisfaction of Wisconsin Engine power increases not only the reliability of equipment in all fields, but also increases the confidence of both equipment user and builder. They're sold on such features as self-cleaning, thrust-absorbing Timken tapered roller bearings at both ends of the crankshaft . . . fool-proof air-cooling, from sub-zero to 140°F . . . an easily serviced OUTSIDE rotary type, high tension magneto with impulse coupling, for quickest any-weather starts . . . plus heavy-duty construction, inside and out.

Your investigation is invited! 3 to 30 hp., 4-cycle single-cylinder, 2-cylinder, and V-type 4-cylinder models.

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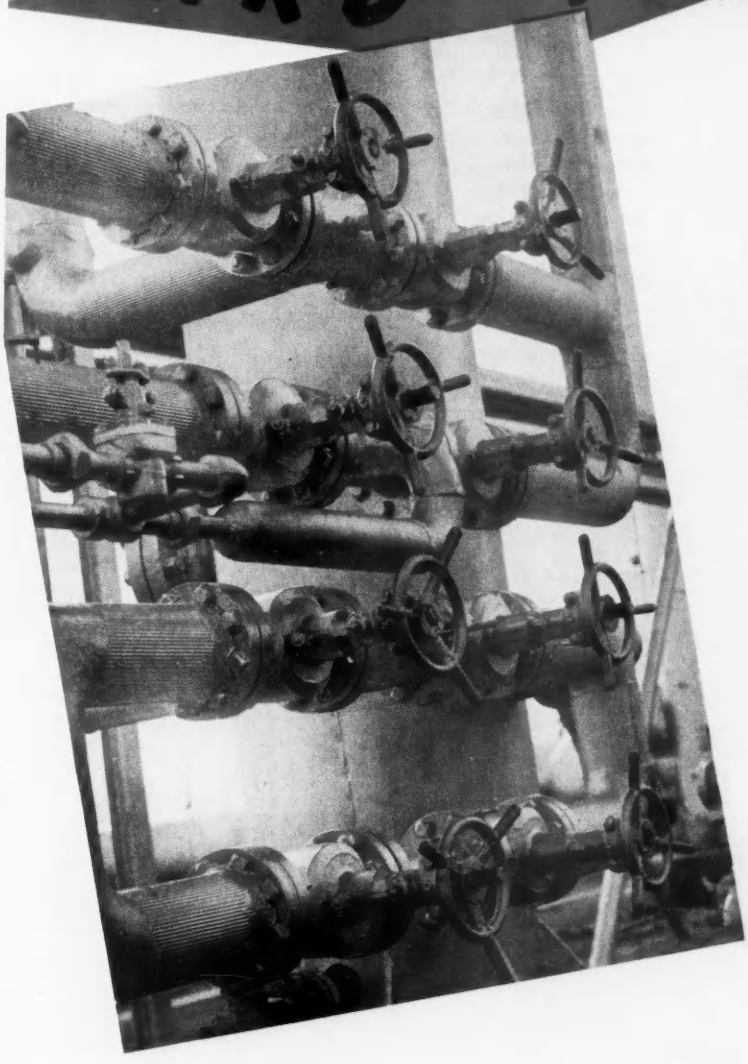

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ORBIT FORGED STEEL VALVES installed on this Propane Dehydrator Unit are giving dependable Service.

ORBIT VALVES shown are Fig. No. LP301-3 3" 300 Lb., Stainless Steel Trimmed.

Orbit Forged Steel LP Gas Valves are Engineered and designed to hold elusive Liquefied Petroleum Gases

Safety, Service and Low Cost performance are engineered into Orbit Forged Steel Valves. The Drop Forged Steel Body and Bonnet are welded together to form an integral pressure vessel—danger of volatile vapor leaks are thus eliminated. ORBIT'S Friction Free Seating Principle gives a positive dependable shutoff. The Stem is Plastic Packed which is permanent and effective. Plastic Packing is Adjustable.

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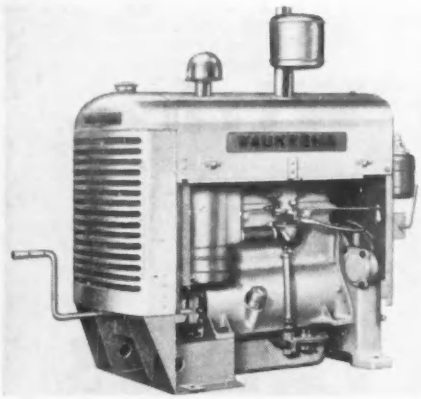
P. O. BOX 699 **TULSA, OKLAHOMA**

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

Power Units



This item supplements Waukesha Motor Company data on pages 4914-4915 of Composite Catalog, 17th Edition.

A series of portable power units built around three basic sizes are made as diesels, gasoline, butane, or natural gas engines, and carry approximately the same output ratings, size for size, whether diesel or carbureted fuels are employed.

Save Time—Write Direct

As a service to readers, all items in WORLD OIL include the complete mail address of the manufacturer. This makes it possible for those desiring additional information to write any manufacturer without the delay occasioned by going through offices of WORLD OIL, and enables subscribers to request specific data in which they are particularly interested.

The four-cylinder model 180-DACU diesel power unit has a continuous output rating of 22 horsepower at 1800 revolutions per minute, while the six-cylinder models 185-DACU and 190-DLCU have ratings of 33 hp and 45 hp at 1800 rpm. The three natural gas, butane, and gasoline, power units which are counterparts of the diesel units, and which have interchangeable mountings, may be supplied with either gas, gasoline, or combination gas-gasoline carburetors. Cylinder blocks, cylinder sleeves, gaskets, governor parts and many other common service items are also interchangeable.

The four-cylinder model 180-GLU, illustrated, has a 3½ x 3¾-inch, 144 cubic inch gas or gasoline engine with a continuous output rating on either 1000 Btu gas or 70 octane gasoline of 25 horsepower at 1800 rpm.

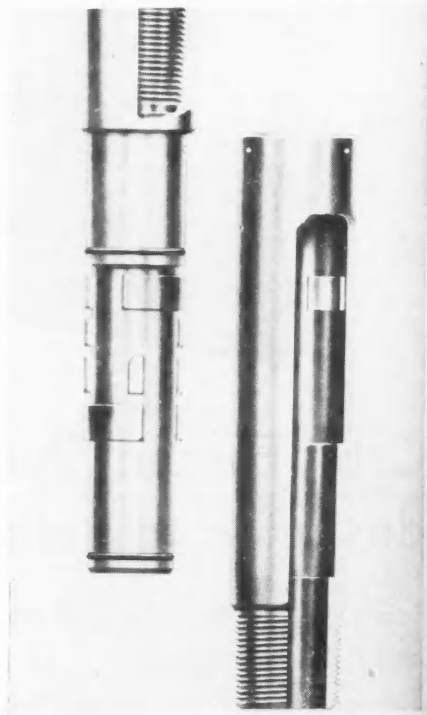
The diesels have American Bosch injection equipment with single plunger pump, pintle type single orifice nozzles, and governor built into the fuel pump.

For additional information write Waukesha Motor Company, 1945 Jay-Vee Drive, Waukesha, Wis.

Tubing Safety Joints

This item supplements Houston Oil Field Material Company, Inc., data on pages 2257-2284 of Composite Catalog, 17th Edition.

Adapted to be equipped with either 16,000-pound or 21,000-pound shear pins, new pin type tubing safety joints provide a flexibility of shear control which eliminates need for having more than a single safety joint. Construction of the



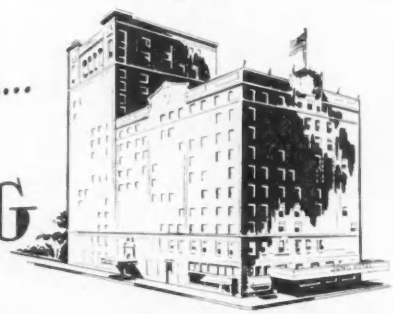
joint permits left or right hand rotation without backing off. A positive seal between the two elements of the safety joint is assured by use of new Silicone type "O" ring packoffs, and the assembly is completely Parkerized to prevent rust and corrosion.

The joint is set above the packer. Inside diameter of the safety joint is the same as that of the tubing, allowing swabbing or wire line work to be conducted through the apparatus without hindrance. Outside diameter of the joint corresponds with the O.D. of the tubing couplings.

For additional information write Houston Oil Field Material Company, Inc., P. O. Drawer 2589, Houston 1.

Preferred in New Orleans...

HOTEL JUNG



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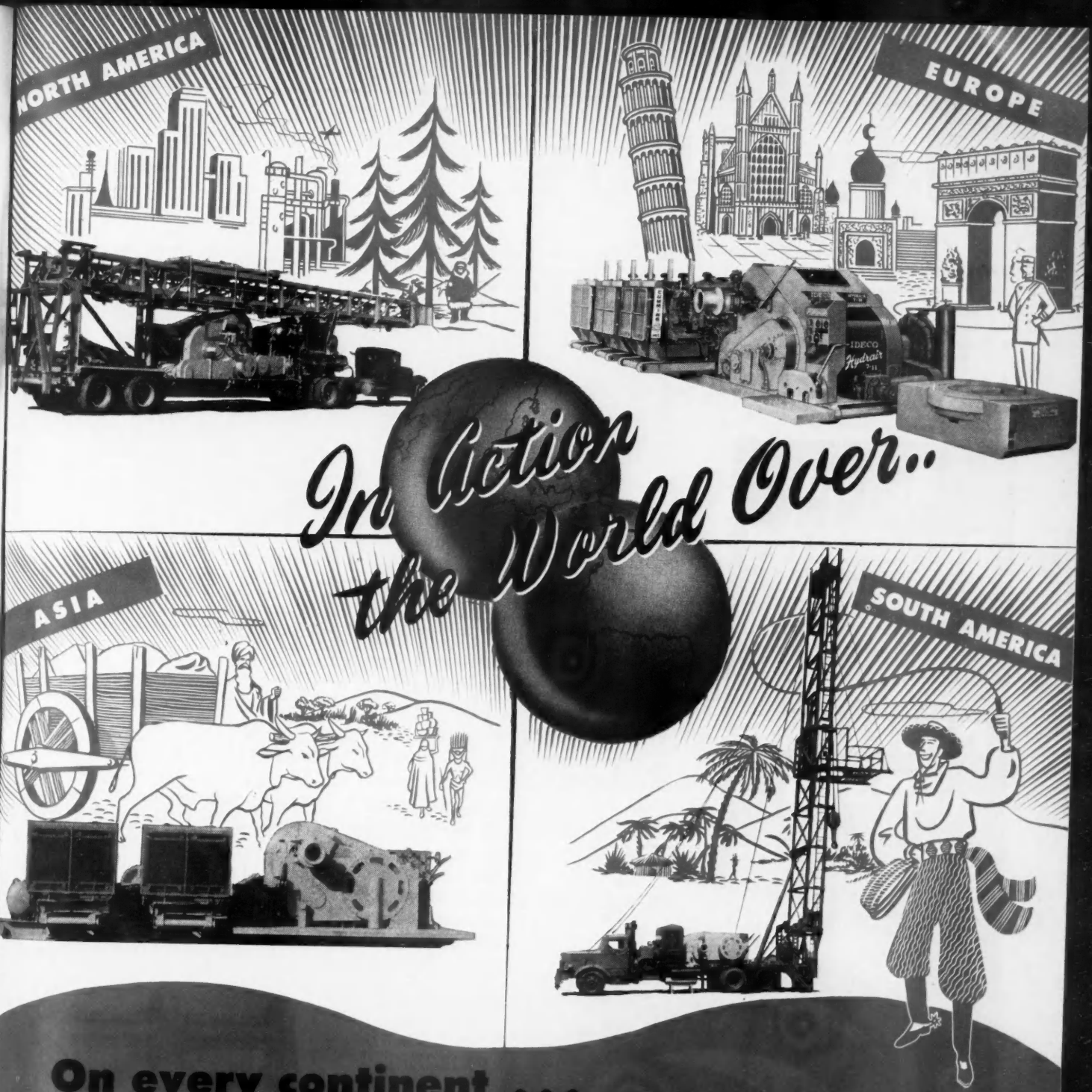
HOTEL MENGER	San Antonio
ANGELES COURTS	San Antonio
VIRGINIA	
HOTEL MOUNTAIN LAKE	Mountain Lake
HOTEL MONTICELLO	Norfolk

THOMAS JEFFERSON
Alabama

ADMIRAL SEMMES
Alabama

AFFILIATED NATIONAL HOTELS



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Filling the most exacting requirements of the purchaser, IDECO Hydrair Rigs are made in a complete range of sizes for drilling shallow to deep wells . . . for servicing the deepest wells yet drilled.

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196 Hydrair Rigs
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ONE OF THE DRESSER INDUSTRIES

NEW EQUIPMENT

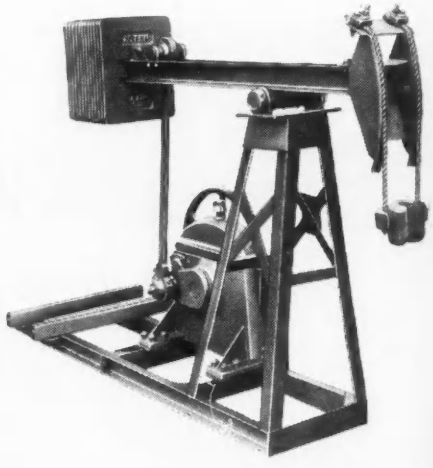
SUPPLEMENTING COMPOSITE CATALOG

Pumping Unit

This item supplements Altens Foundry & Machine Works, Inc., data on pages 201-220 of Composite Catalog, 17th Edition.

A new pumping unit, for very shallow wells, the A20-6, has a structural rating of 2000 pounds. Single reduction ratio of the unit is 11.43:1, and torque rating is 6400 inch pounds. Its adjustable stroke lengths range from 8½ to 14 inches. Nominal horsepower rating of the A20-6 gear reducer at 20 strokes per minute is 1.3.

Samson post, frame and counterweight beam are of rigid, all-welded steel. The self-aligning saddle, wrist pin and pitman bearings are bronze. Less the beam weights, the pumping unit weighs 560 pounds.



For additional information, write Altens Foundry & Machine Works, Inc., Lancaster, Ohio.

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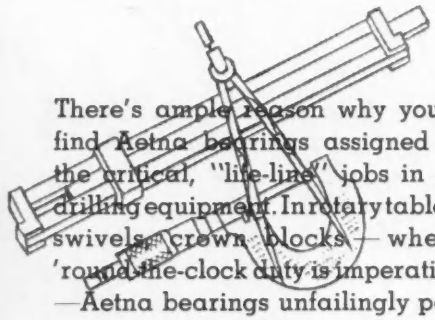

There's ample reason why you'll find Aetna bearings assigned to the critical, "life-line" jobs in oil drilling equipment. In rotary tables, swivels, crown blocks — where 'round-the-clock duty is imperative — Aetna bearings unfailingly pay off . . . avoid costly down-time . . . pare down maintenance expense . . . stretch equipment life.

For your next *vital* applications, SAVE WITH AETNAS . . . the bearings custom-engineered to the *extra* capacity and endurance requirements of oil country machinery.

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Write for Engineering Catalog and name of nearest field engineer.

EQUIPPED FOR SIZES UP TO 38 INCHES O. D.

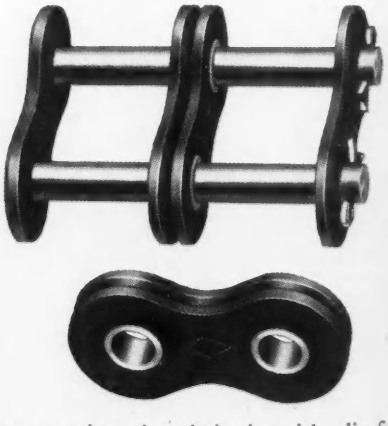
Aetna

BALL AND ROLLER BEARINGS

Connecting Links

This item supplements Diamond Chain Company, Inc., data as shown on pages 1372-1373 of Composite Catalog, 17th Edition.

A bushed center plate connecting link has been developed for use with Diamond multiple-strand roller chain for severe service. This connector's durability closely matches that of the Diamond press-fit center plate multiple-strand chain. The method of connecting and disconnecting the chain is with slip-fit center plate links, thus simplifying the handling of multiple-strand chains.



The new connectors, which are being produced for ¾-inch through 2½-inch pitch Diamond multiple-strand roller chains, have file-hard bushings pressed into pitch holes of pairs of center plates making one unit with the bushings then ground for hole and pitch accuracy.

For additional information, write Diamond Chain Company, Inc., 400 Kentucky Avenue, Indianapolis 7, Ind.

OTHER NEW AND IMPROVED EQUIPMENT

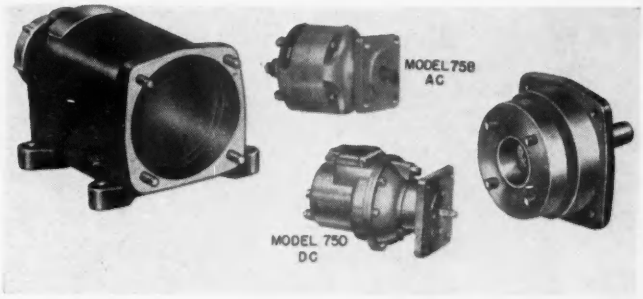
Tachometer Generator

The new Type E tachometer generator can be used where there may be explosive atmospheres. It is available as either an alternating current or a direct current generator.

The Weston Type E tachometer generator is enclosed in a cast iron housing having four feet for mounting. The housing measures approximately 10¼ inches over-all and 4½ inches in diameter. Its ¾-inch diameter stainless steel shaft, with a machined flat for a gear or coupling, extends 1½ inches beyond the bearing support. Electrical connection is made in terminal box tapped to take standard ½-inch conduit.

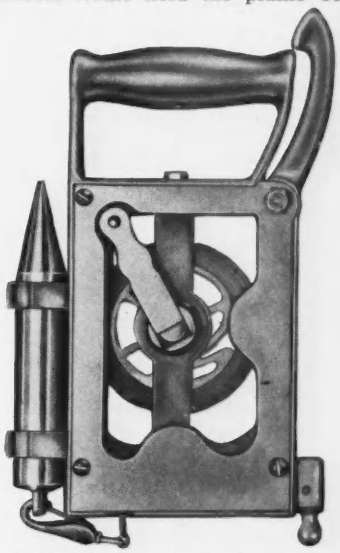
Both ac and dc generators are available for use in the new housing.

For additional information write Weston Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5.



Tape Wiper

The Menke Tapeline Holder and Wiper is a convenient means to handle the steel tapes used in gauging stock tank oil. Its aluminum construction eliminates the danger of sparks. This new tape holder and wiper is designed for all Lufkin and Atlas reels carrying 33, 25 or 18-foot tapes. A thumb brake allows the operator to regulate the fall of the plumb bob into the oil. The tape is automatically wiped clean as it is reeled up. Clips on the side of the aluminum frame hold the plumb bob in place when the tape is not in use. Weight of the holder in only 1¾ pounds.

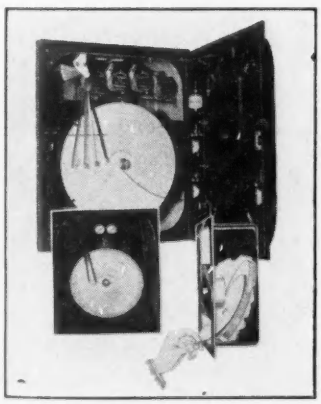


For additional information, write Menke Appliance Company, Box 237, Monahans, Texas.

Recorders

An amplified line of pressure and temperature recorders offers temperature measurement by the self-actuated tube systems of the gas-filled vapor tension and liquid-filled types for ranges from —100° F. to +800° F.

New case design accommodates up to 4 pens, with any combination of temperature and pressure. Storage space is provided within the case for 200 charts and 4 bottles of ink.



For additional information, write for Catalog 750 A, Penn Industrial Instrument Corporation, 3116 North 17th Street, Philadelphia 32.

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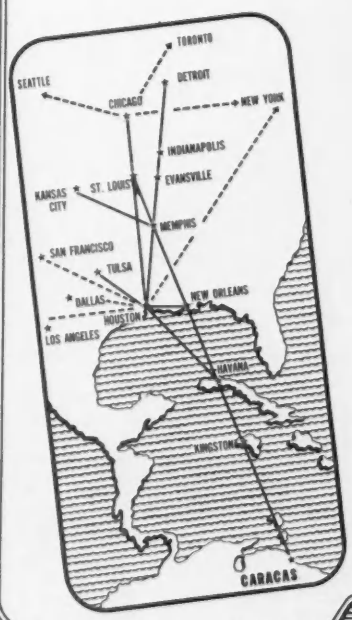
VENEZUELA and JAMAICA!



Chicago & Southern Air Lines' fleet of 4-motored Douglas Skymasters now offers seven-days-a-week service through the Houston and New Orleans gateways to Caracas, Kingston, and Havana. Flights each way every day provide one-plane service from the Great Lakes to the Venezuelan oil capital. Ask your travel agent or nearest C&S ticket office.

CHICAGO & SOUTHERN AIR LINES
General Offices, Memphis, Tenn., U.S.A.

C&S

Steel Tow and Service Boat

Special shallow draft diesel-powered all-steel tow and service boats are being manufactured by Equitable Equipment Company, Inc., which has completed three 42½-foot boats that draw only 15 inches of water.

The beam on these models is 11 feet 1 inch; and the molded depth 2 feet 5 inches. The shell plating is 3/16-inch steel. Cabin, sides and deck plating is 10 gauge with the cabin top of 12-gauge steel. The hull framing is longitudinal with angle space of 16-inch centers. There is a water-tight bulkhead of 10-gauge steel at the forward end of the deckhouse. Cabin insulation is provided by fibre glass, and sheathing is of marine plywood. Windows are aluminum framed.

Motive power is furnished by 107-horsepower General Motors engines. With hydraulic shift and finger-tip control at the operator's station, this is a one-man boat. Electric starting and fresh water cooling systems are built in. The vessel seats 15 or 16 passengers in the cabin.

For additional information write Equitable Equipment Company, Inc., 410 Camp Street, New Orleans 12.

Wax Activator

A new spreading agent, Paraspred, for paraffin and microcrystalline waxes, also plasticizes paraffin wax improving its adhesiveness. Penetration of the wax into porous materials such as paper and textiles is thereby improved, the manufacturer claims.

As little as 1 percent Paraspred added to paraffin wax causes it to spread readily even on damp surfaces, it is claimed.

Higher concentrations enable the wax to penetrate into opaque white paper to give translucence to the paper. Improved adhesive properties of the paraffin also result from the higher concentrations.

Paraspred is a non-toxic, soft waxy solid, cream to yellow in color, with a melting range of 92-97° F. (33-37° C.).

For additional information, write Glyco Products Company, Inc., 26 Court Street, Brooklyn 2, N. Y.

Metal Inspection

A new, portable, and general purpose Magnaflux unit makes all defects, such as invisible fatigue cracks, shrink cracks, weld cracks, etc. readily visible by a magnetic particle indication built up on them by quick magnetization.

The KH-05 Magnaflux unit requires only 110-volt alternating current supply

line to give AC or DC magnetization with safety and flexibility, using low voltage, high amperage magnetizing currents; 500 magnetizing amperes are available. The AC magnetization is best for location of all surface defects such as service fatigue cracks in tools or shafts, and the AC furnishes a powerful demagnetizing field whenever needed. The half-wave rectified DC locates subsurface defects such as internal cracks in welds, and cracks on the inner surface of cylindrical parts.

For additional information, write Magnaflux Corporation, 5900 Northwest Highway, Chicago 31, Ill.

Well Casing

A new deep well casing which permits greater safety and efficiency in deep well drilling is made of quenched and drawn steel having a far higher minimum yield strength than the former top standard grade of casing.

For additional information write National Tube Company, Hammerly Building, Pittsburgh, Penn.

CATAWISSA PERFECT SEAL UNIONS
deliver sure-fire piping dependability THROUGHOUT THE OIL FIELDS!

In high or low pressure, extremely high temperature or corrosive piping conditions, CATAWISSA HOT FORGED STEEL UNIONS are maintaining their long-standing reputation for sure-fire piping dependability!

CATAWISSA PERFECT SEAL UNIONS are designed and produced for dependable, long-life service under the severest piping conditions—made with hand ground seats that require no packing and feature Catawissa's Ball-To-Angle seat design which gives a PERFECT SEAL even when the pipe is not in alignment!

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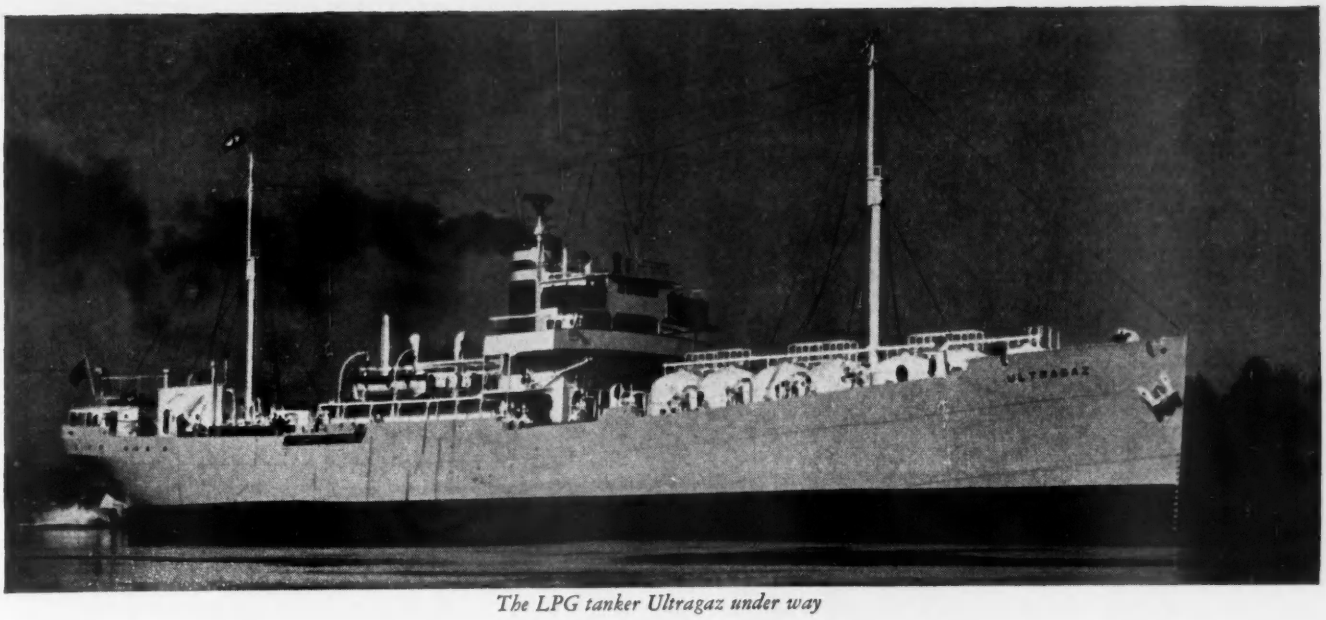


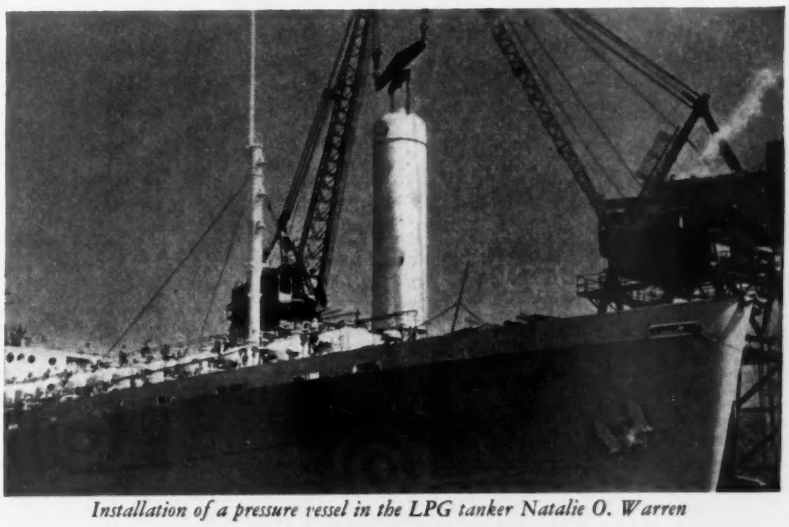
The LPG tanker Ultragaz under way

Liquefied Petroleum Gas Tankers by BETHLEHEM for MAXIMUM Economy Efficiency Safety

The *S. S. Natalie O. Warren* and the *S. S. Ultragaz,* converted at Bethlehem's Beaumont Yard from dry cargo vessels to liquefied petroleum gas tankers, represent the most economical and safest means yet developed for the transportation of bulk propane and butane gases.

They also reflect Bethlehem's ability to design and construct or convert varied craft for the most efficient mass movement of special liquid cargoes over *the oceans or on inland waterways.*

If you are a bulk shipper of special liquid cargoes we would be pleased to show you some of the economic, safety, and control advantages of transportation by specialized ships and barges. Your inquiry will be welcomed by Bethlehem —the nation's outstanding pioneer in the development of economical waterborne transport mediums for petroleum and its products.



Installation of a pressure vessel in the LPG tanker Natalie O. Warren

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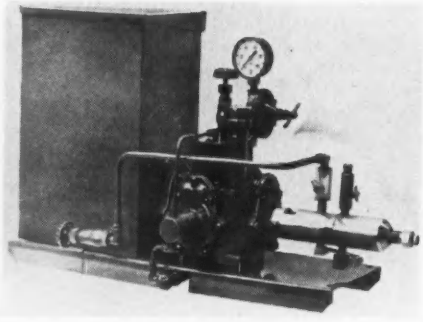
Chemical Injector

A new type of chemical injector pumping unit is comprised of a four-cylinder rotary type, crankshaft motor with an injector unit. The motor is flooded by an oil pump, all parts of which operate in a complete oil bath surrounding the sides of the pistons.

It operates on air, gas or any liquid-type pressure on pressures from one to 75 pounds. As many as three individually-controlled injectors of the plunger type may be used on one motor. The injection volume is constant regardless of temperature changes as each works from the crankshaft and, hence, makes the same length stroke. This pump is adapted to pumping acids as no acid can reach the packing or gaskets.



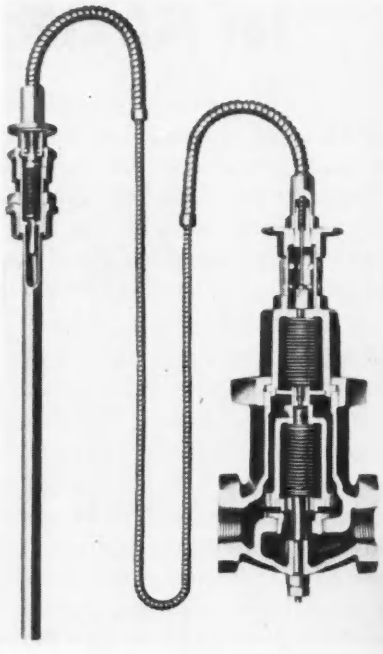
Both standard and custom built models are available. Standard model pump ratio is 256 to 1, width of unit is 8 inches, length 26 inches, weight approximately 49 pounds, tank size 8 x 10 x 15 inches.

For additional information write MacFarland Engineering & Pump Company, 3151 Golfcrest, Houston.

Temperature Regulator

Production has been resumed, with certain design improvements, of Stacon, a self-operated, hermetically-sealed temperature regulator.

Stacon has no packing glands, requires no maintenance and can be operated immersed or in the open. It is intermediate in its field of application between the direct-operated type of regulator and the air-operated type. Temperature change required to move the valve disc full travel is less than three degrees, and plus or minus one degree control is claimed. Temperature adjustment is provided on the bulb for 60 degrees, and special bulb wells are available for corrosive service and to allow removing of the bulb without draining the tank. Size range available is ¼ to 6 inch; ¼ to 1½ inch, single unit; 2 to 6 inch, pilot operated.



Operation is based on a vapor flash principle. As liquid in control bulb expands with increase in ambient temperature, it is forced into a steam jacketed power bellows and immediately flashed to vapor; pressure thus generated extends bellows and moves attached disc toward the valve seat, throttling the valve.

For additional information write Farris Stacon Corporation, 528 Commercial Avenue, Palisades Park, N. J.

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AMAZING THREAD ACCURACY is one reason why Harrisburg Seamless Steel Pipe Couplings are preferred throughout the petroleum industry.

They are threaded on special machines, assuring accuracy of form, height, angle, and lead—meeting the most critical requirements demanded by engineers today.

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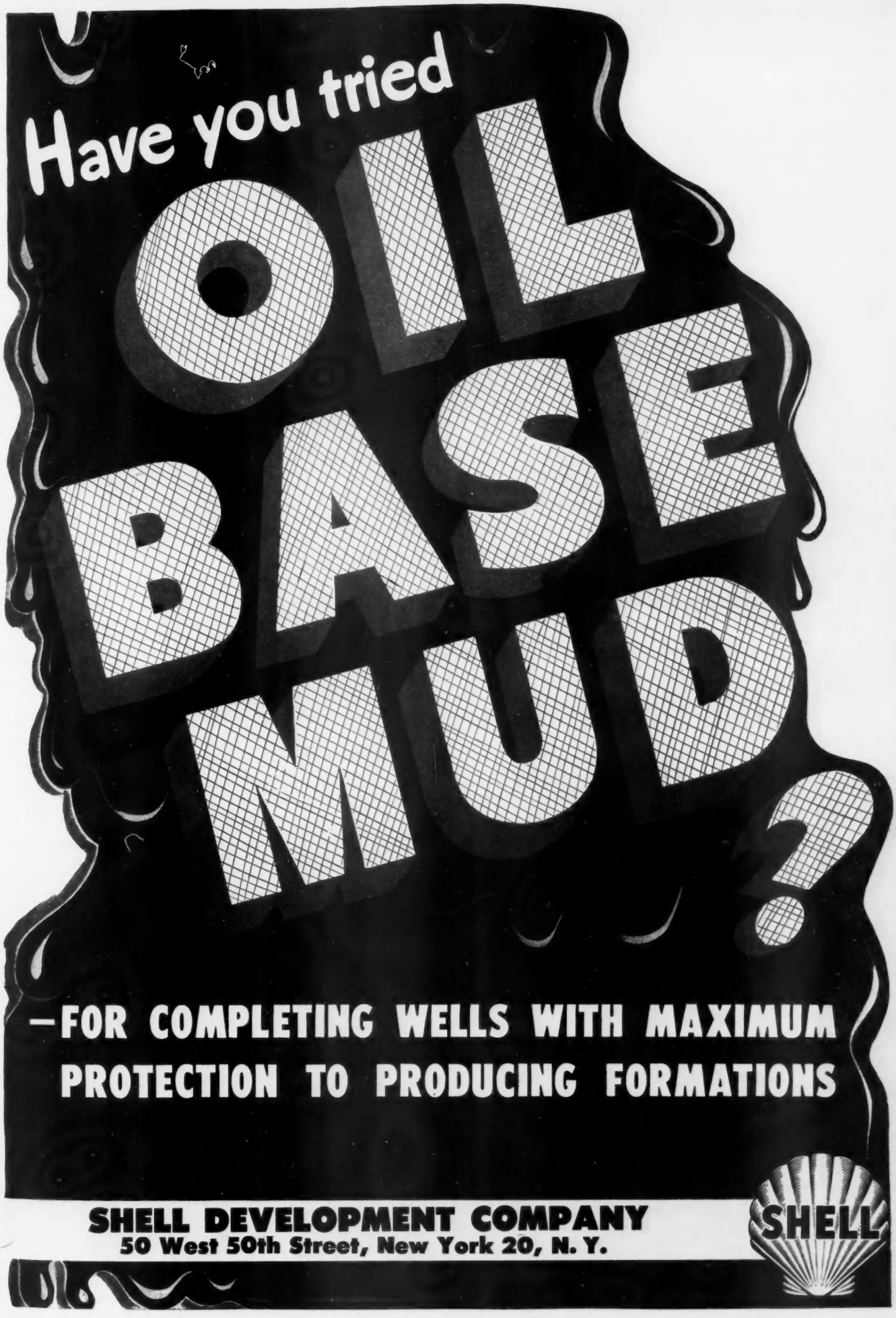
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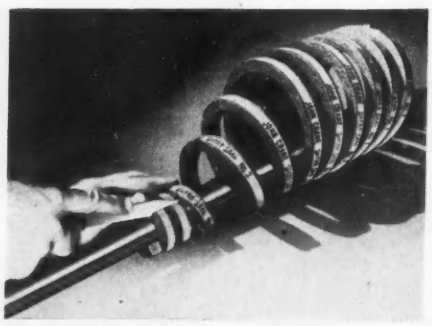
Plastic Packing

A vulcanized tape-back is now offered as an integral part of all "Super Seal" spiral packings.

This development increases packing flexibility and brings a plastic packing into the class of ordinary braided fabric styles. Ring cutting is simplified with this type of reinforcement because the spiral can be twisted down to small shaft sizes, and then cut into rings without breakage.

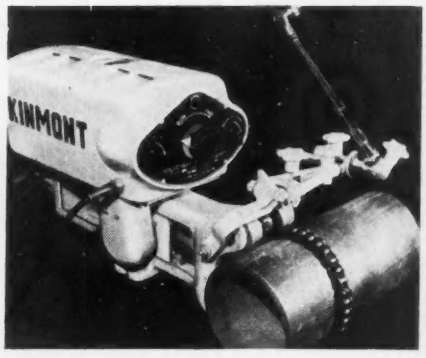
For additional information, write Crane Packing Company, Department P-29, 1800 Cuyler, Chicago 13.



Scarfing Attachment

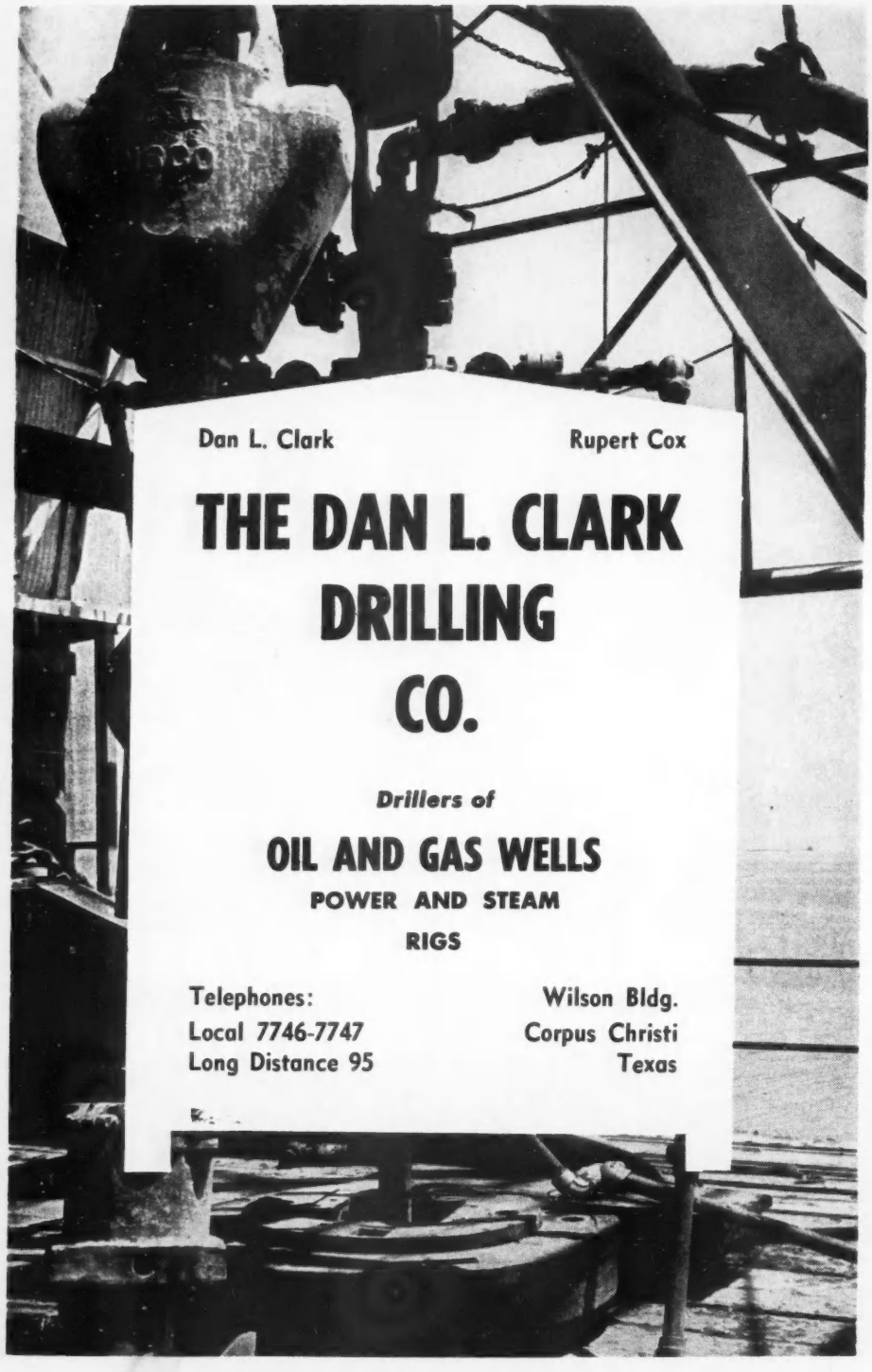
A new pipe scarfing attachment for use with the Kinmont Universal Power Unit provides a means of accurately cutting or scarfing pipe or tanks while they are being turned by the power unit. The attachment is installed through existing bolt holes, without modification or the use of special tools.

Provision is made for vertical and horizontal adjustment of the cutting torch. A protractor dial provides for angular adjustment. The scarfing attachment is hinged to swing the torch out of the way while changing the work, without disturbing the adjustments.



Principal parts used in the attachment are heat treated aluminum alloy castings. Extension rods are steel. The ¾-inch I.D. Torch Tip Holder is supplied with brass tip adapter bushings in sizes of ½, 9/16, and 41/64-inch.

For additional information, write D. L. Leavitt, vice president, Roylyn, Inc., 718 West Wilson Avenue, Glendale 3, Calif.

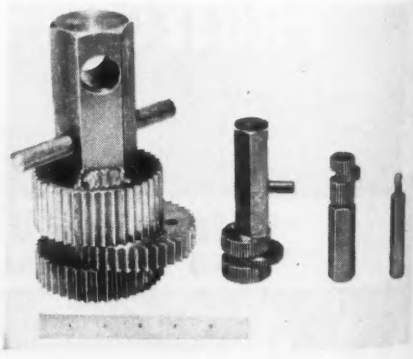


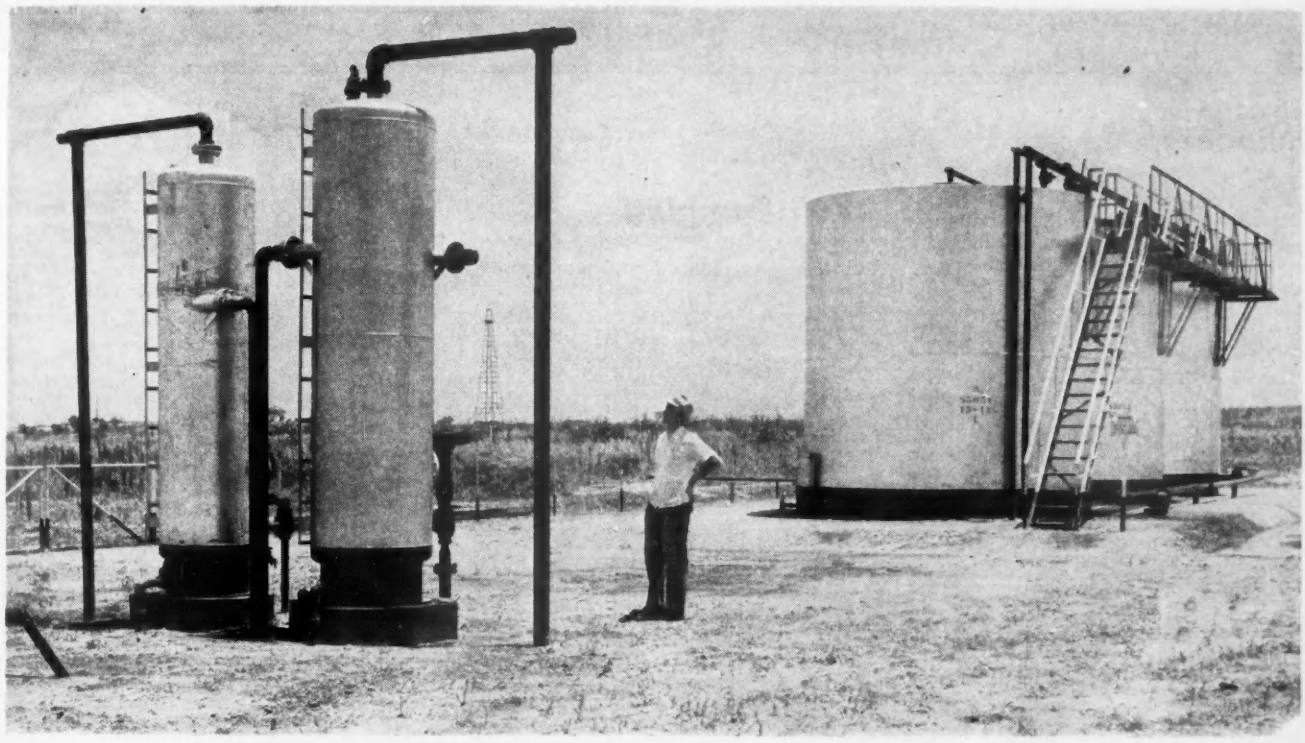
Pipe Wrenches

Roddick internal pipe wrenches, available in ⅛-, 2½-, 3-, and 4-inch sizes, are useful not only where pipe and fittings are involved, but also where electrical conduit or any type of tubing is being used.

With the addition of four new sizes these internal wrenches are now obtainable in all standard pipe sizes from ⅛ to 4 inches; the entire line is available for use with standard, extra-heavy, and double extra-heavy pipe.

For additional information write Roddick Tool Company, 112 Rochester Street, Costa Mesa, Calif.





Sivalls *shop-welded* cone bottom 500 barrel tanks with Sivalls 36" x 13' and 30" x 11' 125 lb. oil and gas separator installed in Scurry County, Texas.

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Cylinders

A 12-page catalog gives dimensions and weights, ratings and limitations of the company's new medium duty line of pneumatic and hydraulic actuating cylinders, and of the heavy duty and super duty lines. Information on the selection of cylinders, and illustrations and designs of rod and head attachments are included.

For a copy of Bulletin 500 write Ledeen Manufacturing Company, 1600 South San Pedro Street, Los Angeles 15.

Well Pumping

A new 47-page illustrated booklet describes electrified oil well pumping, covering every phase of electrification from motors to power supply.

For a copy of Booklet B-4039 write Westinghouse Electric Corporation, P. O. Box 2099, Pittsburgh 30.

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When you standardize on CHIKSAN Mud Handling Equipment, you get uniform strength and safety—from slush pump to well bottom. And, CHIKSAN Equipment gives you proved performance, backed by a quarter of a century of successful operation in oil fields throughout the world.
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Pumping Motors

A 24-page, 2-color booklet contains articles on how to select large motors for oil pumping service; insulation requirements; safety of motor controls; electric power generation for oil field use; electric power generation in field processing plants and in compressor stations.

For a copy of "Synchronizer No. 30," write Electric Machinery Manufacturing Company, Minneapolis 13.

Electrical Maintenance

A series of articles by Fraser Jeffrey, assistant to Allis-Chalmers' chief electrical engineer, on maintenance of electrical machines is available in the booklet, "Care of AC Rotating Equipment."

For a copy of Bulletin 05R7417, Write Allis-Chalmers Manufacturing Company, 1060 South 70th Street, Milwaukee.

Wire Rope

Five new illustrated booklets discuss "Socketing Wire Rope," "Wire Rope Lubrication," "Correct Handling of Wire Rope," "Splicing Wire Rope" and "Wire Rope for Well Drilling." Charts and efficiency tables are included.

For copies of these booklets write Union Wire Rope Corporation, 21st and Manchester, Kansas City 3, Mo.

Valve Seat Pullers

A descriptive price catalog for Red Devil valve seat pullers for slush pumps contains cutaway diagrams, explanations, sizes, dimensions, and complete prices on valve seat pullers and parts for practically all makes of slush pumps.

For a copy of Catalog P-111, write Oil Well Manufacturing Corporation, 6000 South Alameda Street, Los Angeles 1.

Diamond Core Bits

Design and construction features and engineering data on Kobelite Insert Type diamond core bits, core barrels, reamers, milling and washover shoes are included in new 8-page, 1950 catalog brochure.

For a copy of this catalog data write Koebel Diamond Tool Company, 9456 Grinnell Avenue, Detroit 13, Mich.

Crawler Tractors

A new 24-page catalog describing the new International TD-18A crawler tractor is produced in 2 colors. It contains pictures, sectional views, and diagrams illustrating the new crawler tractor.

For a copy of Catalog A-154-NN write International Harvester Company, 180 North Michigan Avenue, Chicago 1.

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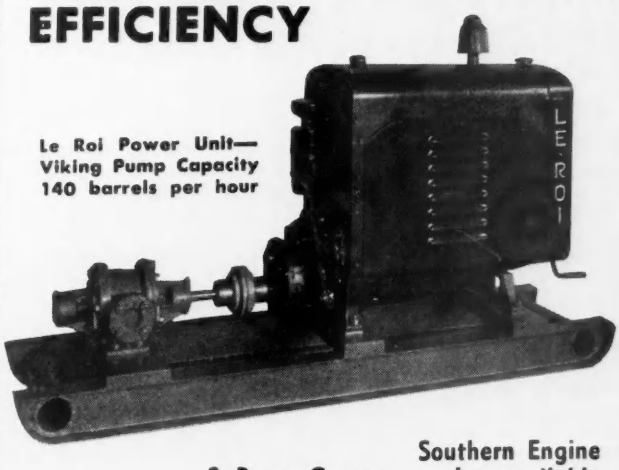

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140 barrels per hour

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Pays for itself in a short time

Hundreds of Cavins Depthometers are in successful service giving their owners direct-reading, accurate well measurements. This strong, simple device comes in a handy carrying case (weighs only 17 pounds)—is put on the line in a few seconds, and tells you where bottom is quickly and dependably. —Write for folder to The Cavins Co., 2853 Cherry Ave., Long Beach 6, California.

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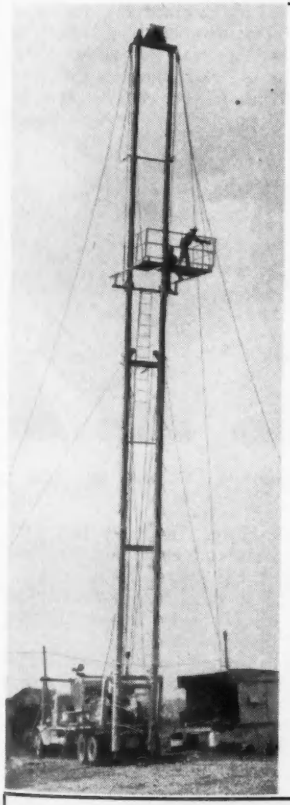

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This S&R double ladder mast is of heavy welded steel construction, and is fabricated of 10¾" pipe and 8⅝" pipe. Overall dimensions when erected 87 feet to crown support beam and 50' 2" when telescoped in travelling position.

Approximate weight of the complete equipment is 12,000 lbs.

The complete assembly includes the (1) poles, (2) breakdown shaft assembly, (3) attached racking platform (which positions itself when poles are raised), (4) pole adjusting screws, (5) a sheave assembly to be mounted on truck or trailer for raising the poles, (6) and a four or five 24 inch sheave crown block for ¾" line.

Available for truck, trailer, or skid mount.

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Men in the Industry NEWS

James Tanham, vice president of The Texas Company in charge of Industrial and Public Relations, has retired.

Tanham joined the company after release from naval service at the end of World War I. Before being elected vice president in 1941, he had been for approximately eight years assistant to the president.

•

W. R. Kemper has been promoted to district land agent for the Corpus Christi district of Shell Oil Company, replacing **H. F. Sartwelle,** who retired after 24 years of service with the company.

Kemper holds an L.L.B. from the South Texas School of Law, Houston. With Shell since 1934, he has served during the past few years as land man for the company in Florida and Louisiana. He was a first lieutenant in the Army during the war.

Sartwell, who joined Shell in 1926 as land man in Baton Rouge, La., was district land agent in the San Antonio district from 1938 until February, 1949. Since then he has been district land agent in Corpus Christi.

•

D. F. Sears, a veteran of 23 years' service with Shell Pipe Line Corporation, has been named assistant to the president. In another high level promotion, **A. F. Terrill** was named area superintendent for Shell Pipe Line in West Texas.

Sears will devote most of his time to special assignments, principally in connection with the construction of a crude oil pipe line which is being built for Shell in Venezuela. Sears joined Shell Pipe Line in St. Louis in 1927 as an engineer. In 1933

D. F. Sears

A. F. Terrill

he was named assistant to the manager, and in 1939, general superintendent and assistant secretary. During the war, he served as chief of the Pipe Line Section, Supply and Transportation division, PAW. He returned to Shell in Houston in 1945 as assistant to the vice president, a post he held until his new appointment. He is also a director of Shell Pipe Line Corporation.

Terrill replaces **W. H. Shelley,** who has been named superintendent of the Venezuelan project. Terrill started with Shell Pipe Line 31 years ago as an oiler. He became assistant personnel manager in 1942, assistant to the superintendent of the Texas Gulf area in 1943 and assistant superintendent of the West Texas area in 1945. His headquarters will be in Colorado City.

Edward F. Morrill was elected president of Mid-Valley Pipeline Company, and **William C. Kinsolving,** former president, was named chairman of the board of directors. Morrill has been a vice president of Mid-Valley since the organization of the company in August, 1949.

Edward F. Morrill

Kinsolving also announced plans to transfer the company's headquarters from St. Louis to Longview, Texas. Mid-Valley offices in Longview are in the Bramlette Building.

Morrill, a graduate of Case Institute of Technology, class of 1929, was employed for three years by the Ohio Bell Telephone Company and then joined The Standard Oil Company (Ohio). Starting as a service station employe, he later joined the transportation engineering division and ultimately became assistant manager of transportation operations and president of Sohio Pipe Line Company.

•

C. J. (Joe) Kerwin and **John H. Douma** have been appointed to supervise Sunray Oil Corporation's Production department activities in the Mid-Continent division. **J. R. Vandever** is general superintendent, with Kerwin assistant superintendent for Kansas, Oklahoma, North and West Texas and New Mexico, and Douma assistant superintendent for Arkansas, Louisiana, Mississippi and Gulf Coast and South Texas.

W. L. Horner, former chief engineer for Barnsdall Oil Corporation, has been named chief petroleum engineer for Sunray Oil Corporation's Production department and will manage all engineering activities in its Mid-Continent division. Other changes resulting from Barnsdall's merger with Sunray include: **J. F. Adkisson, Jr.,** to department supervisor and engineer in charge of water flooding; **George P. Alden,** water flood engineer; **Dr. Charles W. Ziemer,** supervisor reservoir engineering. In the engineering department **R. H. Parks** and **Walter Kellogg** are engineers, **L. B. Jeffers,** proration engineer, and **Burns H. Errebo,** department engineer.

Specialists in engineering department are **R. K. Waddell,** geological engineer; **V. M. Williams,** drilling mud engineer; **W. I. Hagan,** mechanical engineer; and **W. P. Parker,** salt water disposal.

•

James W. McColl, Legal department, Cities Service Oil Company (Del.), Bartlesville, Okla., has been appointed assistant to **H. Ben Cox,** superintendent of the Land department. Other appointments: **A. G. Lawver,** supervisor of administration; **Ed. E. Owen,** supervisor of titles; **Burton Corn,** supervisor of contracts; **R. B. Geisel,** supervisor of gas acreage, Bartlesville office of the Land department. **W. C. Dunlap,** former supervisor of contracts, has resigned to re-enter business at Houston.

•

C. C. Gandaubert, formerly superintendent of the Production department's Southern division, has been named general superintendent of General Petroleum Corporation.

E. V. Watts, production superintendent of the Southern division, advances to Southern division superintendent. **A. W. Titus,** senior production foreman of the Beaches area, replaces Watts as production superintendent of the Southern division, and **H. C. Carrothers,** production foreman, becomes senior production foreman, replacing Titus at General Petroleum's Long Beach field office.

Gandaubert has general supervision of the three California divisions of the Production department, headquarters of which are located in Vernon, Ventura, and Taft. He joined General Petroleum in June, 1920 as a tool dresser in the Ventura oil fields. He became a driller in 1924 and worked throughout most of the San Joaquin Valley and Southern California oil country in this capacity. He became a drilling foreman in 1937 and assistant superintendent of the Southern division in 1947. He has held the post of division superintendent since January 1, 1949.

Watts received his engineering degree at the California Institute of Technology in 1936 and joined General Petroleum three months later as a roustabout in the Lost Hills field. Within a year he became an engineer at the company's Vernon head-

C. C. Gandaubert

E. V. Watts

quarters. Since July, 1949 he has been production superintendent of the Southern division.

Titus joined General Petroleum in January, 1924, and has been senior production foreman since July, 1948.

Carrothers, who has been with General Petroleum since June, 1923, has served as a production foreman in the Wilmington area since 1942.

J. J. Schillinger, right-of-way agent for General Petroleum, has been advanced to the post of assistant manager of the Right-of-Way department.

Schillinger is a veteran of 22 years' service with General Petroleum. He joined the company as a messenger at the age of 17 and has worked for the General Petroleum continuously since that time.

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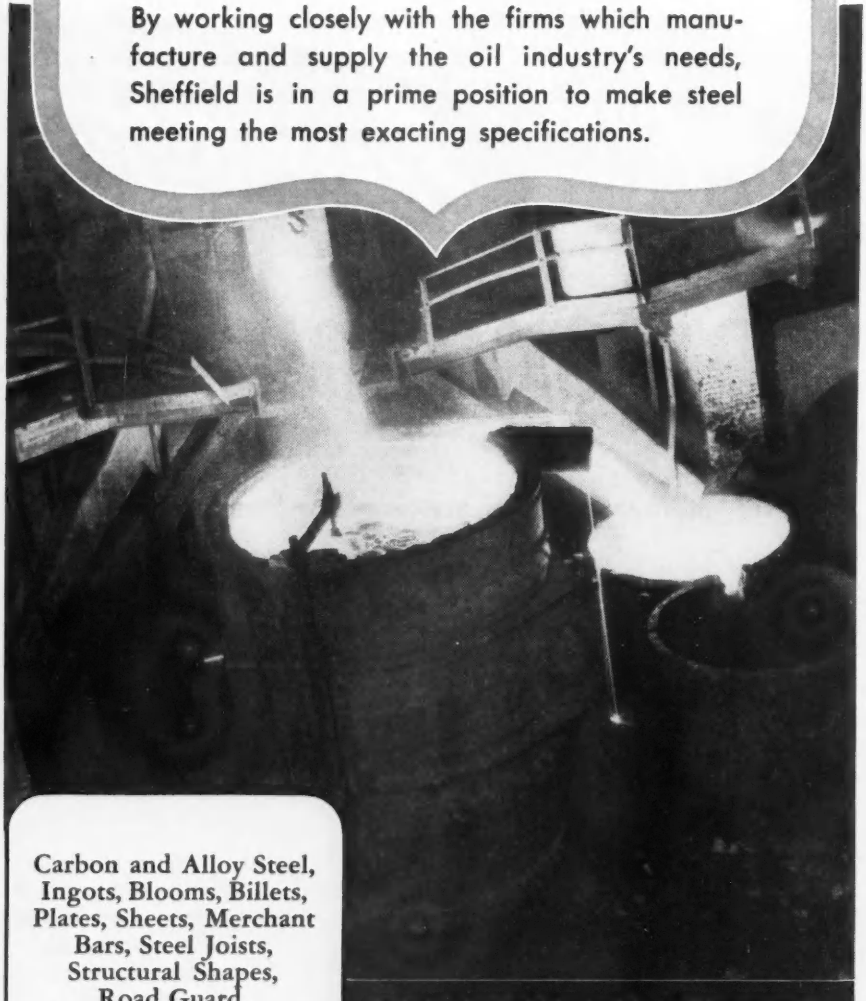

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MEN IN THE INDUSTRY NEWS

Transfers and Promotions:

Don Bills, geologist, Cities Service Oil Company, has been transferred from West Texas to Olney, Ill. . . . **B. B. Ford**, supervisor at Seminole, Okla., for Tide Water Associated Oil Company, has been transferred to Chickasha, Okla. **E. L. Layman** has moved from Drumright, Okla., to Seminole . . . **Roy Reese**, district engineer at Seminole for Amerada Petroleum Corporation, has transferred to the Velma, Okla., district . . . **Robert J. Garrett**, geologist at Oklahoma City for Superior Oil Company of California, has been transferred to Bahrein as manager of company operations in the Middle East . . . **A. J. Monzingo**, who has been petroleum engineer in Magnolia Petroleum Company's Kermit Producing district, has been transferred to the West Texas division's offices at Midland as petroleum engineer. He is succeeded by **E. G. Bilderback, Jr.**, formerly petroleum engineer at Luling, Texas . . . **R. E. Powers** was transferred from East Texas to the Shreveport office as district engineer for Arkansas Fuel Oil Company, succeeding **Lawrence Fennell**, resigned. **E. L. Cook**, district engineer at Alice, Texas, moved to East Texas, and **C. H. Stout** was transferred from Shreveport to Alice as district engineer.

Don E. Hammond, formerly at Hominy, Okla., has been made production foreman at Seminole for The Pure Oil Company. **Leroy Conn**, Abilene, Texas, and **James H. Parrish**, Midland, Texas, both geologists for Pure, have been transferred to Fort Worth . . . **Frederick H. Callaway**, formerly senior petroleum engineer, Stanolind Oil and Gas Company, Tulsa has been promoted to reservoir engineering supervisor, Producing department . . . Peak Drilling Company and **Joe Reznik** have transferred headquarters from Carmi, Ill., to Evansville, Ind. . . . **C. E. Brehm** has transferred his geological department from Evansville, Ind., to Mt. Vernon, Ill. . . . **J. H. Wogan**, Shell Oil Company, Wichita, Kansas, has been transferred to Oklahoma City as division chief clerk . . . **W. L. Kennedy, Jr.**, and **L. E. Anderson**, Service Pipe Line Company, Tulsa, have been promoted to planning engineer in the Planning and Economics department, and to hydraulic engineer, respectively. **W. N. Stivers**, Casper, Wyo., district superintendent, has been transferred and promoted to assistant manager, Oklahoma division. **S. L. Cox**, Casper, area engineer for the company's Wyoming and Nebraska divisions, was promoted to district superintendent, replacing Stivers. **C. F. Gearhart**, Tulsa, was promoted from senior engineer to area engineer replacing Cox at Casper. **F. M. Willenburg**, Shawnee, Okla., has been transferred to Fort Worth as assistant division manager, Central and East Texas division. **Ellis Orr**, Carrollton, Mo., industrial relations supervisor, Illinois and Missouri divisions, has been transferred to Drumright as assistant to **J. E. Langhorn**, district superintendent.

Paul Grant, geologist, Gulf Oil Corporation, has been transferred from Amarillo, Texas, where he was district geologist for seven years, to the Fort Worth division . . . **J. F. Jeansonne**, district petroleum engineer, Humble Oil & Refining Company, Production department, transferred from the Mallalieu district, Louisiana division, to the Odessa district, West Texas division.

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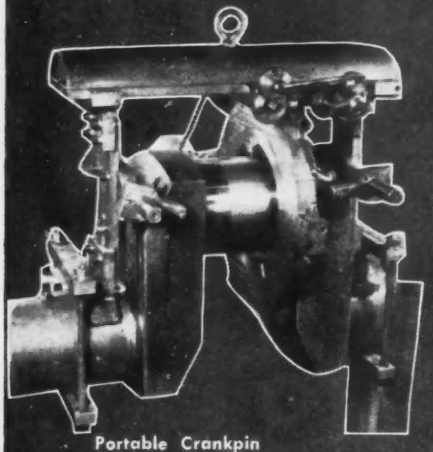

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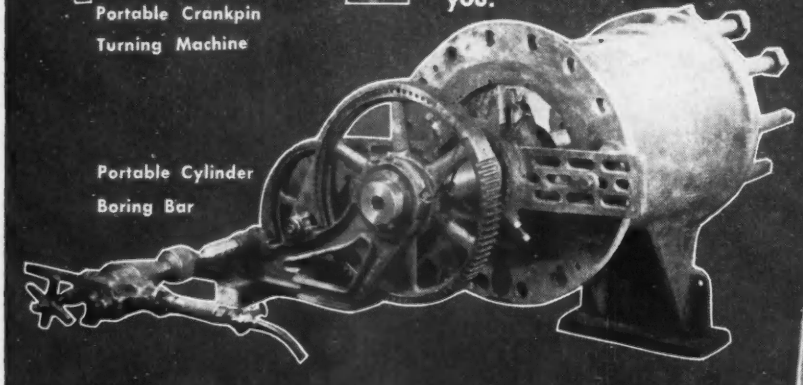

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MEN IN THE INDUSTRY NEWS

T. J. Files has been named division attorney for Stanolind Oil and Gas Company at Casper, Wyo.

T. J. Files

Files received his law degree from the University of Texas in 1930. Before joining Stanolind in 1935, he was associated with the trust department of the First National Bank of Chicago, and later with the law firm of Renfro and McCombs, Dallas attorneys.

He was employed by Stanolind as a landman in the Houston division office in February, 1935. In July of that year he was transferred to the Tulsa general office at title man in the land department. He has been an attorney in the Tulsa office since March, 1942.

Roy S. Reed, formerly labor relations supervisor for Stanolind, Tulsa, has been named employee relations supervisor, succeeding the late **Homer L. Chapman.**

•

John A. Barnett, Jr., has resigned as district geologist, Seaboard Oil Company, at Abilene, Texas, to become an independent geologist and oil producer. He is succeeded by **John Skelly,** formerly in the Dallas office.

•

Willard G. Wiegel, personnel director, Lone Star Gas Company, Dallas, Texas, has been elected treasurer, succeeding **H. G. Cornatzar,** retired.

•

Sam A. Garfield and **M. Danenberg** have organized the Gardan Drilling Company with offices at Evansville, Ind.

•

Fred A. Schell has retired as division production superintendent in Oklahoma, Kansas and North Texas, for Tide Water Associated Oil Company after more than 51 years in the oil industry of which more than 30 years has been with Tide Water. **Harold E. Berg,** formerly division engineer, succeeds Schell.

•

George M. Jenkins has resigned as district geologist at Shreveport for Stanolind Oil and Gas Company to join the La Gloria Corporation supervising operations in the Ark-La-Tex division.

•

L. G. Stubbs, formerly district exploration manager for Barnsdall Oil Company at Wichita, Kansas, has opened an office as a consulting geologist.

•

Elbie McNeil has joined Derby Oil Company's geological staff at Wichita, replacing **Gerald Pike,** resigned, who has joined Pickrell Drilling Company, Wichita.

•

George L. Ellis has been named division geophysical coordinator for the North Texas-New Mexico division of Stanolind Oil and Gas Company.

•

Robert M. Swesnik has resigned as division exploration manager for Southern Oklahoma, Anderson-Prichard Oil Corporation, Oklahoma City, to become assistant to the chief geologist, General American Oil Company of Texas, Dallas.

MEN IN THE INDUSTRY NEWS

A. W. Baucum has been promoted to assistant to vice president, Producing department, domestic, The Texas Company, and transferred from Houston to New York.

Baucum, who has been assistant to manager, Producing department, since April 1, 1948, was graduated from Texas A. and M. College with the B.S. degree in petroleum engineering in 1934. That same year he started to work for The Texas Company as a roustabout at Freer, Texas. After working as junior petroleum engineer at Jennings Ranch field and, later, at Pierce in charge of field engineering work, Baucum was transferred to the South Texas division office in Houston in 1938 and served in various petroleum engineering assignments.

He was appointed division petroleum engineer of the Oklahoma-Kansas division at Tulsa in April, 1944. Baucum was named assistant division manager, South Texas division, October 1, 1946.

•

Gerdes W. Rice has been appointed superintendent of the right-of-way and claims department, Lone Star Gas Company, Dallas, succeeding the late Ralph H. Shaw.

•

Dr. John C. Calhoun, Jr., has resigned as chairman of the petroleum engineering school, University of Oklahoma, to become head of the petroleum and natural gas division of the school of mineral industries at Pennsylvania State College.

•

U. R. (Bill) Laves, formerly with Kirkpatrick and Bale, Inc., has opened a consulting office in the Apco Tower, Oklahoma City, to specialize in oil and gas industry valuation reports.

•

R. F. Baker, vice president in charge of Domestic Producing operations, The Texas Company and **A. C. Long**, vice president in charge of Foreign Operations (Eastern Hemisphere), were elected directors of the company.

J. S. Leach, vice president in Houston, was elected executive vice president with headquarters in New York. He continues as a director.

•

Paul Lamer, geologist, has been placed in charge of Oklahoma City district headquarters of Intex Oil Company, Dallas, Texas.

•

Ernest Loveless, Wichita, Kansas, is now associated with Freeman Lomelina as geologist at Olney, Ill.

•

Marshall R. Joy has resigned as superintendent of production, Toklan Production Company, Tulsa, to become superintendent of drilling, construction and production for the Brazos Oil and Gas Company, Michigan, subsidiary of Dow Chemical Company, with headquarters at Rosscommon, Mich.

•

Wayne Kinison has been named a new safety instructor in the Mid-Continent area for the Shell Pipe Line Company.

•

B. S. Cheesman has been made assistant to the division exploration supervisor of The Atlantic Refining Company at Tulsa.

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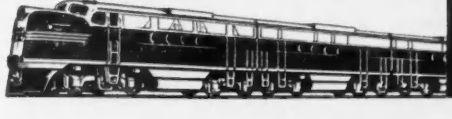

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MEN IN THE INDUSTRY NEWS

W. E. Ferguson has been appointed manager of production of The Ohio Fuel Gas Company at Columbus, Ohio. He had been assistant manager since 1944.

W. E. Ferguson

Starting as a draftsman for the Logan Gas Company in 1917, he became chief engineer in 1924 and following the merger of the Logan with The Ohio Fuel Gas Company he was made assistant chief. In 1930 he became superintendent of the Lease and Engineering departments which he held until his appointment as assistant manager of production.

•

W. A. (Tony) Newhoff, vice president of Union Oil Company and manager of the Central territory has retired. He had been associated with Union Oil Company more than 30 years.

F. K. Cadwell, manager of the company's Northwest territory with offices in Seattle, is now manager of the Central territory with offices in San Francisco. **A. D. Gass,** Seattle district manager, has been named manager of the Northwest territory.

•

Howard D. Henderson, Sohio Petroleum Company, Oklahoma City, has been promoted to manager of the Land and Exploration department. **Walter Findley** has been named western representative for Industrial Relations department for Sohio with headquarters at Oklahoma City.

•

James W. Templeton has been promoted to general auditor of The Texas Company, to succeed **B. E. Emerson,** who has retired after 43 years' service with Texaco. **C. N. Ferguson,** special auditor has been advanced to assistant general auditor.

Templeton, who started with the company 28 years ago, has been assistant general auditor since February, 1949.

Emerson began his career in the oil business in 1904, and joined The Texas Company at Dallas in 1907. He was named general auditor in 1939.

Ferguson started with the old Indian Refining Company in 1917, and was transferred to The Texas Company in Houston in 1935. He was made special auditor in 1941.

•

R. J. (Buck) Hurt has resigned as district landman in the Southwest Texas area for Pan American Production Company to enter the lease brokerage business. He has opened an office at 414 West Vanderbilt Street, Corpus Christi, Texas.

•

D. B. Layer has been named acting division geologist for Imperial Oil, Ltd., at Calgary, succeeding **Dr. E. W. Shaw,** transferred to Toronto as staff advisor.

MEN IN THE INDUSTRY NEWS

Charles K. Gamble, vice president and director of Standard-Vacuum Oil Company, has retired after nearly 35 years of international petroleum experience.

Gamble graduated cum laude from the University of California in 1911. Starting in the oil industry in 1916, he served in Near East operations before going to Australia and New Zealand in 1927. There, in 1938, he became managing director and chairman of the board of Vacuum Oil Company, Proprietary, Ltd. During World War II he was awarded the medal of Merit for his work as commissioner for the American Red Cross in the Southwest Pacific Theater.

He was named a director of Standard-Vacuum on his return to New York in 1945 and a vice president the following year.

•

J. B. Moorhead has resigned as district geologist for Continental Oil Company to open a consulting office in Wichita Falls, Texas.

•

Ihsan Ruhi Berent, president of Maden Tetkik ve Arama Enstituso (M.T.A.), government oil agency of Turkey, has resigned and will enter the engineering consulting business in Ankara. His business address will be Ataturk Bulvari, Bolu Apartment, Ankara.

Ihsan Ruhi Berent

Berent, a mining engineering graduate of the New Mexico School of Mines in 1933, is well known in international oil circles for his numerous articles on the mineral resources of Turkey.

•

G. H. Fisher has been promoted from chief petroleum engineer with Gulf Oil Corporation, Fort Worth, to manager of supply and service. **F. E. Hatfield,** formerly production superintendent, has been named manager of exploitation, and **H. M. Bayer,** formerly chief geologist, is now manager of exploration.

•

M. W. Kibre was appointed manager of the Gas department of General Petroleum Corporation, Los Angeles. He succeeds **H. L. Eggleston,** resigned.

A chemistry and engineering graduate of the University of California, Kibre joined General Petroleum in 1929. He was successively a chemist in the Gas department, an engineer, superintendent, and, since 1945, assistant manager. He is a former president of the California Natural Gasoline Association, Los Angeles.

•

Thad C. Hoke has resigned as vice president in charge of exploration for British-American Oil Producing Company, to become an independent operator and geological consultant in Tulsa.

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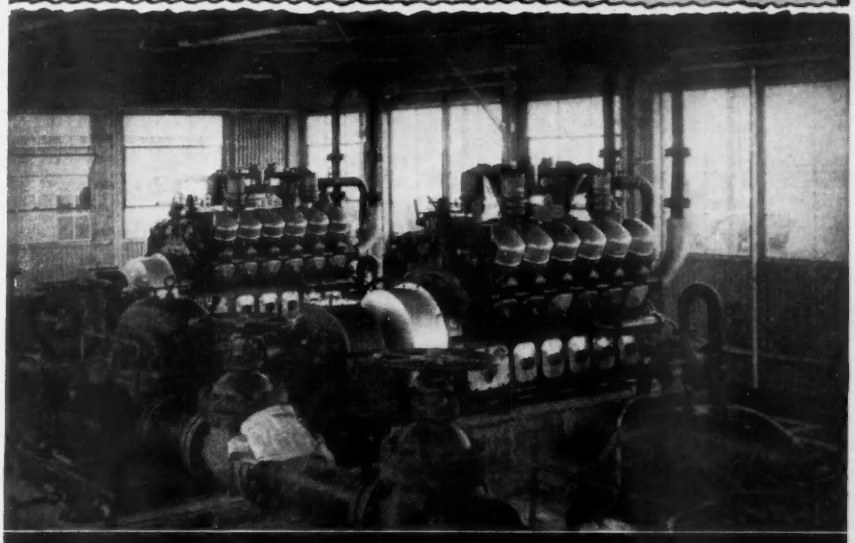

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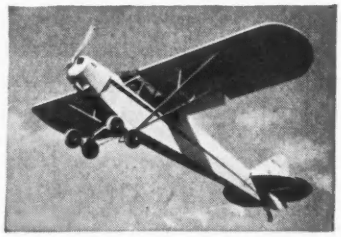

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MEN IN THE INDUSTRY NEWS

John T. Hollingsworth has been named assistant general production superintendent of Signal Oil and Gas Company to succeed the late **Harry C. Meyer.** He will make his headquarters in Los Angeles and report directly to **Richard H. Smith,** Signal's general production superintendent.

Until this advancement, Hollingsworth had been the superintendent for the Santa Maria area which included the operations on the Edna Lease near Pismo Beach, Calif.

•

J. A. (Jack) Cleverley, Bartlesville, Okla., has been appointed assistant general superintendent, Oil Production division, Cities Service Oil Company. He has been with Cities Service 30 years and has had wide experience in all phases of oil field operation.

J. A. Cleverley

•

N. M. Baird has been appointed assistant manager of the Production department, Operating division, American Republics Corporation, replacing **D. V. Marshall,** resigned. Baird was formerly superintendent of the Western division, with offices in San Angelo. He is now in Houston.

H. L. Miers, formerly field superintendent of the Hull district, is the new superintendent of the Western division. He has been replaced at Hull by **A. L. Beasley,** previously production foreman, Silsbee district. **R. M. Martin** succeeds Beasley at Silsbee.

•

V. G. Feather has resigned from the Honolulu Oil Corp. to open a consulting office in Midland, Texas.

Before going with Honolulu Feather worked for Phillips Petroleum Company and Kerr-McGee Oil Industries, Inc.

•

Louis Franklin, Houston geologist and drilling contractor, has been in charge of exploration work in Guatemala for the past 9 months. His Guatemala address is Pension Asturias, Guatemala City, C. A.

•

Dan Kralis, consultant, has been retained as geological advisor to Robinson Bros., oil producers, who have opened exploration offices at 232 White Building, Abilene, Texas.

•

William N. Cones has been elected vice president in charge of production and exploration for Panhandle Producing & Refining Company, Dallas.

Cut well reworking costs-

with the HUNT HYDRAULIC PULLING TOOL

The Hunt Hydraulic Pulling Tool is designed especially for pulling liners or packers when reworking wells. It attaches to the bottom of the tubing or drill pipe and provides high pulling capacity directly above the fish. All the pulling strain is taken by the pulling tool—none is transferred to the fishing string. The Pulling Tool has three parallel-operating slip segments which set the tool firmly in position in the casing letting the drill string "float" above. After the slip is set, hydraulic pressure provided by the surface pump is amplified 60 times to provide a breaking out pull far more powerful than the drill string could support. When the fish is free, the slip is collapsed and the fish is lifted out by the drill string.

Saves time and money by retrieving packers or liners in one trip.
Eliminates pulling strain on drill string or tubing. No danger of breakage.

The Hunt Hydraulic Pulling Tool may be rented with a Hunt Operating Crew for service anywhere in the United States, or may be purchased for export. The tool is made for all sizes of casing.

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FIELD SHOPS: BAY CITY & CORPUS CHRISTI, TEXAS; JENNINGS & HARVEY, LA.
EXPORT SALES: HUNT EXPORT COMPANY, 19 RECTOR ST., NEW YORK; HOUSTON, TEXAS; BUENOS AIRES; PORT OF SPAIN; CARACAS

A BUSINESS BUILT ON *Good* SERVICE

P. S. Magruder has been named president of Grand Valley Pipeline Company, a new firm formed by General Petroleum Corporation, **M. B. Garman**, and Public Service Company of Colorado. Garman is vice president and secretary of the new company, and **F. T. Parks**, vice president in charge of gas operations for Public Service, is vice president and treasurer.

•

Basil R. Jackson has been appointed deputy chairman of Anglo-Iranian Oil Company, Ltd., to succeed **Sir H. B. Heath Eves**, who resigned as deputy chairman and managing director but remains on the board.

Jackson was representative of Anglo-Iranian in the U. S. until December 1, 1949, when, after joining the board as a director, he returned to London permanently.

•

Burt R. Bay has retired as president of Northern Natural Gas Company, but will continue as a director of the company. He is succeeded as president by **John F. Merriam**, formerly executive vice president.

Bay joined the company in 1938 as executive vice president and director, and was made president in 1939. He had previously been vice president and general manager of Panhandle Eastern Pipeline Company.

First in

CANADA'S OIL FIELDS

Alberta today is one of the most active areas of oil exploration in the world with almost double the number of producing wells and output than a year ago. The Royal Bank, with 57 branches in Alberta, opened its branch in the oil field territory in Turner Valley in 1928 and followed with branches in Leduc, Devon and Redwater as development expanded. We know the oil fields and the men responsible for the development.

Our branches in Calgary and Edmonton can supply up-to-the-minute and factual information for operators, equipment manufacturers and all who seek sound advice on establishing connections in Western Canada.

If you have any interest in Canada's oil fields, address your enquiry to:

E. B. Durham, *Supervisor* The Royal Bank of Canada, Calgary, Alberta

We do not provide information on oil securities

THE ROYAL BANK OF CANADA

Over 735 branches in Canada, the West Indies, Central and South America. New York, London, and Paris. Head office, Montreal.

Canada's "Oil" Bank **ASSETS EXCEED $2,334,000,000**

H. H. Hewetson has resigned as a director and chairman of the board of Imperial Oil Ltd., and **J. R. White** has been appointed executive vice president.

J. R. White

Hewetson began his career in the oil industry at Imperial's Sarnia refinery following demobilization from RAF after World War I. Later he served with various companies in the United States and South America, and returned to Imperial at Toronto in 1935. He was successively a director, vice president and president, and became chairman of the board in 1949. He was recently elected a director of Standard Oil Company (N. J.), of which Imperial Oil is an affiliate.

White, a graduate of the University of Toronto, entered Imperial's service at Sarnia in 1933 as draftsman and engineer. He went to the U. S. in 1937, and in 1938 to the Standard Oil Company of Venezuela, becoming a vice president of that company in 1942. In 1944 he returned to Imperial Oil and was elected a director. He became a vice president in 1945.

•

Ray Fickel, geologist for Sinclair Oil and Gas Company at Amarillo, Texas, has been transferred to Houston. He is succeeded at Amarillo by **Don Gibson. Corwin Smith** has moved from Houston to Amarillo to replace Gibson.

•

Bob Becker has resigned from The Ohio Oil Company to join the geological staff of British-American Oil Producing Company, Oklahoma City.

•

F. W. (Fritz) Mueller is now manager of the Geological and Land departments of Heep Oil Corporation, Brown Building, Austin, Texas. He was formerly with Rutherford Oil Company, and before that with Skelly.

•

William D. Lewis has been advanced to senior geologist with General Petroleum Corporation in the Bakersfield offices.

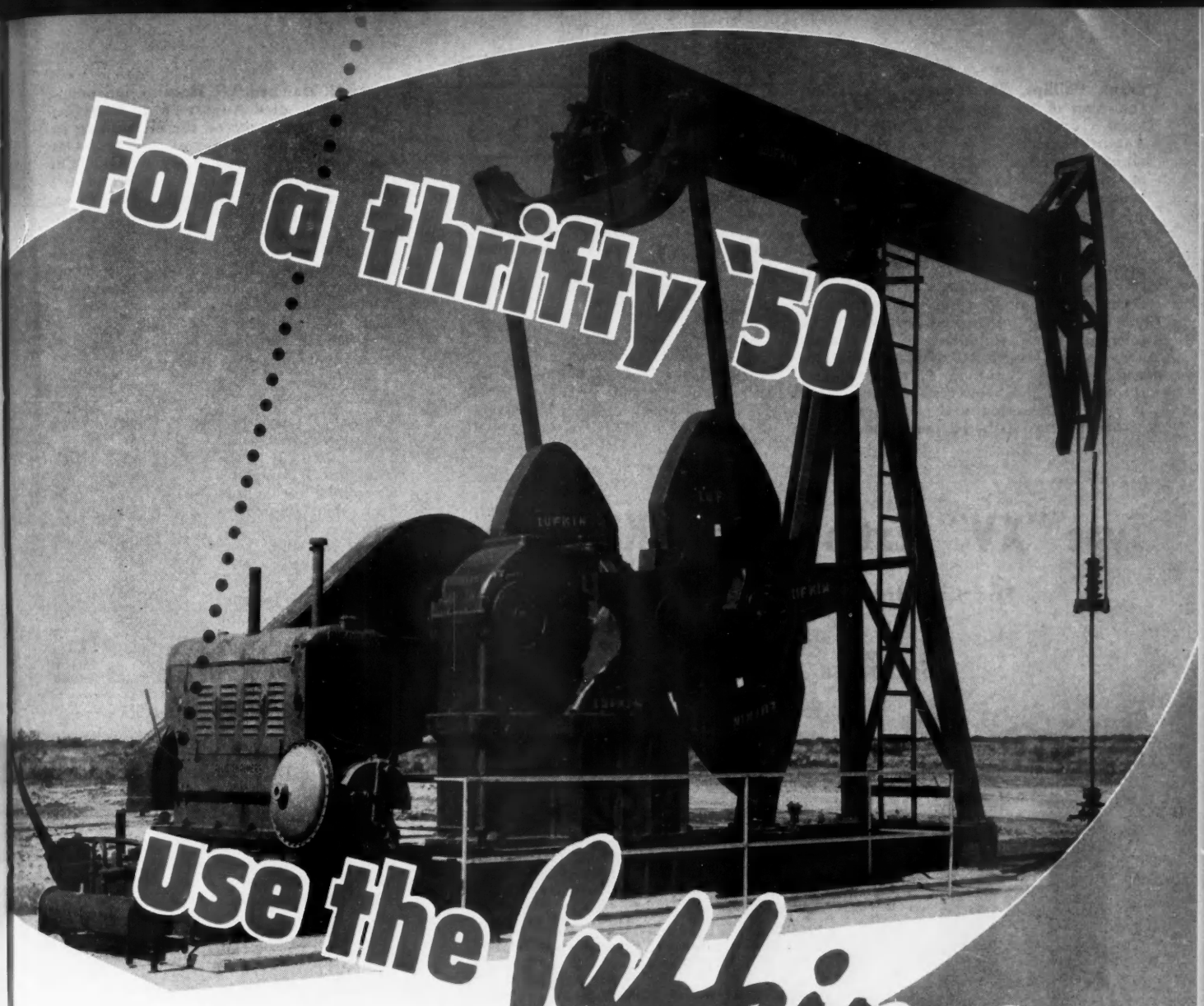
Lewis, who has been with General Petroleum since 1945, joined the company in Los Angeles as an assistant geologist and became a member of the Bakersfield office in 1948.

•

Marshall E. Parker has established offices as a consulting corrosion engineer at 2023 Jean Street, Houston, and will specialize in corrosion surveys and cathodic protection.

•

Alvin P. Loskamp, manager of operations of the West Texas division for Union Oil Company of California, has resigned to enter private business. He is succeeded by **E. R. Atwill**, who for the past eight months has been Union's manager of operations for the Rocky Mountains division, with headquarters in Denver.



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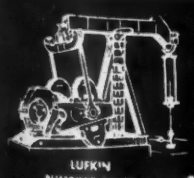
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LUFKIN-COOPER-BESSEMER ENGINES

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INDUSTRIAL SPEED REDUCERS AND INCREASERS

DIVISION LUFKIN FOUNDRY & MACHINE COMPANY
INDUSTRIAL, MILL AND AUTOMOTIVE SUPPLIES

DEATHS

Frank Phillips, 76, founder and retired chairman of the board of Phillips Petroleum Company, died in Atlantic City August 23. Phillips' colorful career in the oil industry began in 1903, when he started in the banking business at Bartlesville, Indian Territory. Banking extended into oil operations, and in 1917 he and his brother, **L. E. Phillips,** incorporated Phillips Petroleum Company. He served as president of Phillips Petroleum for the first 21 years of the company's history, and then in 1938 stepped up to chairman of the board. In 1949, when he asked to be relieved of responsibilities of active management, he was elected honorary director and honorary chairman. A noted philanthropist, Phillips' interests included the Boy Scouts, aviation, and education, to all of which he contributed much money and time.

Dr. Alexander Rosenberg, 59, head of the Land and Lease division of the Producing department, Socony-Vacuum Oil Company, Inc., New York, died August 2 in New York.

•

Charles S. Lockwood, 81, retired Skelly Oil Company employe and a war-time defense official, died August 23 in Ventura, Calif. He had been with Skelly for 17 years, retiring in 1940 to become head of the filing office department with the Office of Civilian Defense in World War II.

Harry C. Hanszen, 66, Houston independent oil man, died August 26 at Kerrville, Texas. Hanszen entered the oil business in 1906 as a scout for Gypsy Oil and Gas Company, now a subsidiary of Gulf Oil Corporation. He rose to a vice presidency of Gulf and moved to Houston from Beaumont in 1916. He left Gulf in 1921 to become an independent oil operator, and organized the Calcasieu Oil Company. At the time of his death, he was a director of Mikton Oil Corporation and Fifteen Oil Company of Houston. Active in civic affairs, he had served for four years as chairman of the board of trustees of The Rice Institute.

•

Sidney B. Iverson, 42, vice president of Iverson Supply Company, Tulsa, died at Midland, Texas, August 7. He joined the supply firm, then known as Iverson Tool Company, in 1928, two years after it was founded by his father, the late **P. M. Iverson.** He had served the company in Midland and Oklahoma City, as well as in Tulsa. He attended the University of Oklahoma.

Sidney B. Iverson

•

Dr. George Dillon Morgan, 56, chairman of the board of Cooper Gas Company, San Angelo, Texas, and former geologist for Empire Gas and Fuel Company of Oklahoma, died August 18. At one time he served as a vice president of Stanolind Oil and Gas Company, Tulsa, resigning in 1930 to move to San Angelo and become active in Permian Basin development. He organized Cardinal Oil Company, which he sold in 1945 to Helmerich & Payne, Inc., of Tulsa.

•

Joseph Louis Martin, 53, president of Wichita Falls River Oil Company, died August 4 in Wichita Falls, Texas.

•

John Irwin (Shorty) Sloan, 46, oil tool equipment inventor and designer, died August 3 in Tulsa. He had invented processes and equipment for drilling mud mixing.

•

Warde Evans, retired special traffic representative for Baroid Sales division, National Lead Company, died August 15. One of Baroid's first service engineers, he joined the company in 1929.

•

E. H. Moore, independent oil man and philanthropist of Tulsa, and former U. S. Senator of Oklahoma, died September 2. Born on a Missouri farm, he lived to build one of Oklahoma's big oil fortunes and to become the third Republican senator in the state's history.

•

Harry T. Earl, vice president of Tide Water Associated Oil Company, died August 10 in Oakland, Calif. Earl had been with Tide Water more than 46 years.

Type "XV" (Extra Volume) King Swivels

For Circulating Large Fluid Volumes

Be Sure IT'S A KING *Be Safe*

Type "XV" King Swivels are designed specifically for drilling conditions where the circulation of greater quantities of drilling mud is required than can be handled by conventional models of small swivels.

In addition to oversize watercourses, King Type "XV" Swivels provide many exclusive features that make them the first choice everywhere for Water Well Drilling, Geophysical Drilling, Working Over, Drilling Shallow Oil Wells, Core Drilling, Drilling in and Coring with Reverse Circulation.

Check these outstanding advantages you get with King Type "XV" Swivels:

- OVERSIZE WATER COURSES assure Large Fluid Volume.
- MOULDED RUBBER PACKINGS ELIMINATE the stuffing boxes.
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- THE PACKING AND WEAR-BUSHINGS can be renewed within a very few minutes without removing any other part from the swivels.
- ANGULAR-CONTACT BALL BEARINGS provide ample thrust capacity and insure radial stability.
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Owen D. Story, 47, manager of Shell Oil Company's regional purchasing and stores department in Houston since 1947, died August 27 in Los Angeles.

•

Frank Cremin, 70, pioneer Tulsa, Okla., oil operator, died August 26 in Tulsa. He was a native of Pennsylvania and went to Tulsa in 1906, participating in Oklahoma's early day oil developments.

•

Clyde Cantner, 55, drilling contractor and oil producer, died July 31 at Bixby, Okla. A native of West Virginia, he went to Oklahoma in 1913 and participated in oil activities in Bartlesville, Drumright, Bristow, Kellyville and Leonard, Okla.

DEATHS

Charles W. Flint, 66, Tulsa oil field equipment manufacturer, contractor and industrialist, died August 5, at Santa Fe, N. M. Flint was president and owner of Tulsa Rig, Reel and Manufacturing Company and Flint Steel Corporation. He was also president and owner of Flint Rig Company, American Steel Derrick Company, Agarine Oil and Gas Company, Mud Products Company, and Flint Industries and Flint Construction Company, both of Venezuela, S. A. Active in civic affairs, he served on the board of the Grand River Dam Authority following his appointment by the late Gov. E. W. Marland of Oklahoma.

Aubrey William Schofield, 52, Gulf Oil Corporation official, was killed August 31 in a plane crash in Egypt. A graduate of the University of Pittsburgh, Schofield joined Gulf's Houston Production division in 1924, and in 1937 was made superintendent of drilling and production for Mene Grande Oil Company's eastern Venezuelan fields. He served with the U. S. Air Force during World War II, returning to Gulf in 1945 as a member of the Executive department of the Houston Production division. In 1946 he was appointed assistant managing director of Kuwait Oil Company, Ltd., with residence in London. He was assigned to New York City in 1949, as manager of Eastern Hemisphere operations, Foreign Production division. At the time of his death, he was acting manager of Kuwait Oil in London.

•

C. P. Davis, 61, former Tulsa oil producer, died September 6, in Oklahoma City. He had been associated in Tulsa with the Revelee Oil Company and the Carcol Oil Company.

•

Herman I. Axelrod, 65, president of Gibson Machine and Tool Company, and the Marlow Oil Company, Borger, Texas, died September 5, at Borger. A native of Poland, he came to the U. S. in 1899 and after working in the oil fields in Ohio and West Virginia until 1911 moved to Bartlesville, Okla. He went to Borger in 1932.

•

W. A. Markham, 87, prominent Oklahoma independent oil man, died August 25 in Broken Arrow, Okla.

•

Edward L. Crabb, 44, Tulsa, section head of Amerada Petroleum Corporation's accounting department, died August 26. He had been with Amerada since 1930.

•

Lester G. Wheeler, 65, independent Oklahoma oil operator, died September 4, at Cushing, Okla.

•

David A. Carter, 54, pioneer Oklahoma oilman and long-time district foreman for Sinclair Oil and Gas Company at Wewoka, Okla., died August 13 in Tulsa.

•

Carroll Mills Morrow, 27, illustrative draftsman with Dowell Incorporated, died August 11 in Tulsa.

•

Don J. Gamble, 44, assistant superintendent of the shops department, The Carter Oil Company, Tulsa, died August 5. He had been with Carter since 1937.

•

Lloyd C. Morris, 40, administrative supervisor of Phillips Petroleum Company's Research department, died August 3 at Bartlesville, Okla. He had been with Phillips about 15 years.

•

Edward L. Klepfer, 62, independent oil man and former major league baseball player, died August 9 in Tulsa.

•

Bernard M. Laulhere, 64, former manager of engineering services for Southern California Gas Company, died August 5.

We wish to announce the opening of our new store at

SNYDER, TEXAS

It is fully stocked with all needs for the drilling and producing of oil.

The store is located four miles west of Snyder on Highway 180 (Lamesa Road) in the heart of the Kelly section of the Scurry County Oil Field. It is the closest Supply store to the "Diamond M" and "Sharon Ridge" Canyon pools in Scurry and the "Von Roeder" and "Reinecke" pools in Borden County.

We want all our old customers who are operating in this area to use to the full our facilities there. Also to the operators who have not known us before we will welcome any chance they will give us to be of service to them.

Our Telephone Number at Snyder is 1353

THE PRODUCERS SUPPLY & TOOL CO.

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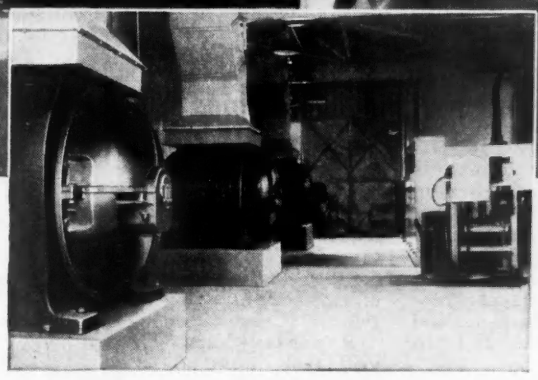
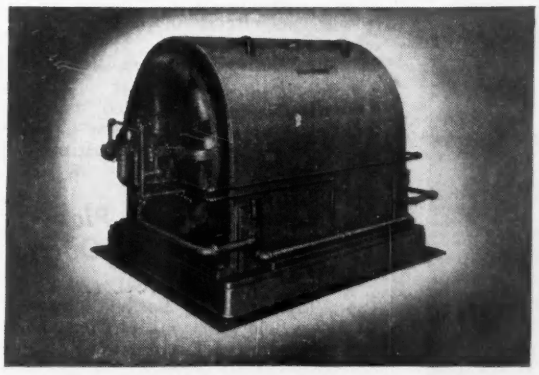
MOTORS TO MATCH YOUR PIPELINE NEEDS

No firewall is needed between pumps and motors when you use G-E explosion-proof motors, as with these two 400-hp motors direct coupled to main pumps in a Pennsylvania pipeline station.



Where a firewall is called for by station design, choose G-E squirrel-cage open induction motors for low-cost reliability. Here, three 1500-hp motors of this type, with top air-discharge enclosures, drive the pumps through a firewall in a Southern pipeline station.



No firewall is used with this 1500 hp G-E externally forced base-ventilated motor, one of several now being installed in a large Southwestern crude line. A separate motor-driven blower purges the motor and duct system of hazardous gases. Air ducts are located below the floor level.

Broad range of G-E motors makes correct selection easier

When you make General Electric your single supply source for all your electrified pipeline needs, you're sure of the widest variety of motor types and sizes to choose from:

Motors that meet any area condition—low-cost open motors to operate behind a firewall, or enclosed motors designed for use in hazardous areas which require no firewall.

Motors for centrifugal or reciprocating pumps—squirrel-cage induction motors of relative simplicity and low cost for centrifugal pumps, or synchronous motors with high operating efficiency and ability to improve load power factor for reciprocating pumps.

Motors for constant or adjustable speed—constant-speed motors direct-coupled to centrifugal pumps for lowest installed cost, or wound-rotor induction motors to supply adjustable speed for more efficient operation at reduced flow.

All these G-E motors offer the advantages of fast and easy installation, minimum maintenance, and long-lasting dependability. Selected with the aid of G-E application engineers who know pipeline industry needs, they're a good bet to help cut your pumping costs. For the full story, call your nearest G-E office. *Apparatus Dept., General Electric, Schenectady 5, N. Y.*

Worth seeing! It's "Lease on the Future", G-E's More Power to America movie on oil field electrification. Ask your G-E representative to arrange a showing.

Everything you need
to cut oil pipeline costs
—ELECTRICALLY!

GENERAL ELECTRIC

Effect of War Crisis on Oil Will be Discussed by IPAA

The 21st Annual Meeting of the Independent Petroleum Association of America, being held at the Jefferson Hotel, St. Louis, October 1-3, is of more than usual significance this year in view of the current international crisis and its implications to the oil industry. More than 1000 independent oil and gas operators have registered to hear spokesmen for the petroleum industry, the oil-producing states and the federal government participate in a comprehensive industry discussion which highlights this year's sessions.

J. Ed Warren, Midland, Texas, IPAA president, will sound the keynote for the meeting and following his annual report the Association will elect a board of directors and will hear the report of its nominating committee headed by J. P. Evans, Sr., Shreveport.

Russell B. Brown, general counsel of the Association, will report on the oil situation in the nation's capital and his address will be followed by reports from the Association's magazine, Interstate Oil Compact Drilling Contractors, and Federal and Public Lands committees.

Of wide concern to the industry is the report by IPAA's Oil and Gas Field Materials committee headed by Bryan W. Payne, Tyler, Texas. The committee was appointed to survey the steel and material needs of the oil industry and to make recommendations which would guarantee equitable distribution of such equipment. It is scheduled to report at a committee luncheon Monday, October 2. Following Payne's report, H. J. Wallace, vice president in charge of sales, National Tube Company, will be the principal speaker at the luncheon.

Standing committees of the Association, including Secondary Recovery, Natural Gas, Tax Policy and Advisory, and Resolutions will conclude their reports during the afternoon Monday and the Economics Committee will release its semi-annual supply and demand forecast at this time.

The Association's president, executive committee, officers and vice presidents will be elected at the close of business Monday, Oct. 2.

Highlight of the meeting will be the concluding session Tuesday, October 3, which will feature an oil industry "Report to the Nation" forum designed to point up the oil industry's preparedness in relation to the present emergency, as well as its public service facilities "from well to consumer." Merle Becker, past president of IPAA and chairman of its program committee which planned the forum, describes it as a "package story" by oil industry and government leaders of "how oil affects the lives, comfort, happiness and security of 150 million Americans 24 hours a day."

Major B. H. Hardey, Shreveport, past president of IPAA, will be Forum Moderator, and speakers include IPAA President Warren, on Production; Frank M. Porter, API president, on Transportation, Refining and Distribution; Col. E. O. Thompson, member Texas Railroad Commission, on Oil and Gas Conservation; Gov. Roy J. Turner of Oklahoma, chairman Interstate Oil Compact Commission, and Walter S. Hallanan, chairman, National Petroleum Council, on the Work of the Council, as well as a high representative of the federal government.

The Forum, which gets under way at 9:30 a.m. Tuesday, will close the IPAA meeting. It will be preceded by the showing of a new oil industry film; "Twenty-four Hours of Progress" completed recently by the Oil Industry Information Committee.

Attorney Joins TIPRO Staff As Director of Membership

Alvis Vandygriff, attorney and former chief clerk of the Texas General Land Office, has joined Texas Independent Producers and Royalty Owners as general counsel and director of membership activities.

Alvis Vandygriff

Recently Vandygriff took leave-of-absence from his Land Office post, which he had held since 1939, to be executive director of the Statewide Citizens Economic Committee. SCEC activities toward publicizing the effects of oil imports on the Texas economy have been discontinued as a result of the Korean war.

TIPRO also announced that it has moved its offices to the new Commodore Perry Hotel Building in Austin.

Permian Basin Show Planned For October 19-22 in Odessa

Planned as an "oil field workers' show," the 1950 Permian Basin Oil Show will give the field worker a chance to see new developments and applications of the tools he uses, Lloyd French, oil show board president, announced. More than 60,000 persons are expected to visit the show, which will be held October 19-22 at Ector County Park in Odessa, Texas.

Odessa, Texas' largest domestic oil field supply point and a key trucking center in the nation's oil industry, is playing host to the show. However, directors of the show come from every city in the Permian Basin.

The Permian Basin Chapter of the API will meet on the opening day of the show. On the following day, the Permian Basin sections of AAODC, AIME and the geological society will have a joint meeting.

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WATER CANS
& COOLERS
GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug fitting large removable top, handy non-leaking push button faucet. GOTT Water Cans for handy field use. Your Supply Store has them, get one today! . . . .
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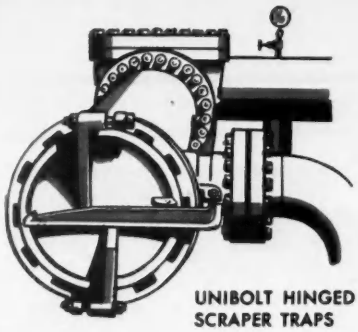
Made in 2, 3, 5, 8, 10, 15 and 20 gallon sizes with Push-Button Faucet.
GOTKOOL WATER CAN
Made in 1½, 2, 3, 5, 10, 15 and 20 gallon sizes. (Push-Button Faucet at slight additional cost.
H. P. GOTT MFG. CO.
WINFIELD, KANSAS
KEEP PURE DRINKING WATER ALWAYS HANDY

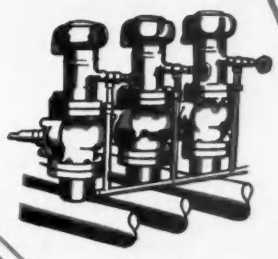


UNIBOLT HINGED SCRAPER TRAPS

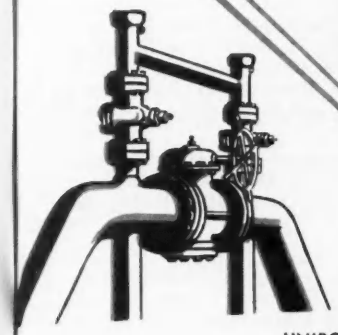
Pipeliners

ARE MAKING THE MOST OF A GOOD THING...

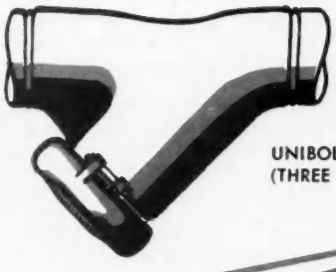
UNIBOLT



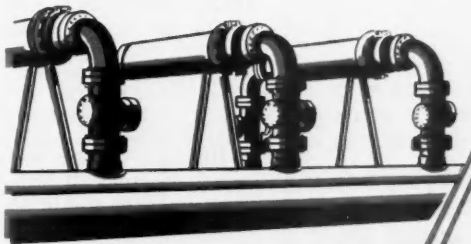
UNIBOLT COUPLINGS WITH BLANKING PLUGS ON TERMINAL MANIFOLDS



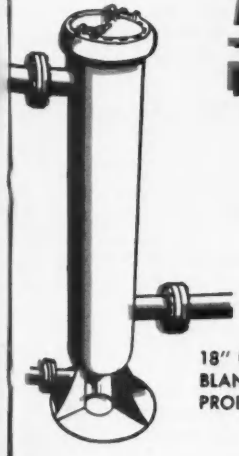
UNIBOLT COUPLINGS WITH BLANKING PLUGS ON GAS LINE BLOWDOWN



UNIBOLT STRAINERS— (THREE TYPES)



24" UNIBOLTS ON MAIN LINE GAS SCRUBBERS



18" UNIBOLT WITH BLANKING PLUG ON PRODUCT LINE FILTER

On any pipeline connection where flanged unions or closures are now used, a UNIBOLT Coupling can be employed to real advantage.

One, UNIBOLT provides a safer, stronger, joint because the unique UNIBOLT design places more metal in shear.

Two, UNIBOLT provides a more convenient connection or closure because of its time-saving design and blanking plugs which are available with a hinge to facilitate opening and closing.

Three, UNIBOLT provides a light-weight, less bulky unit which is economical, completely salvageable and interchangeable.

Presented here are the most common uses of UNIBOLT Couplings and blanking plugs in pipeline service. Complete details on each product will gladly be sent on request. Inquiries are invited on special pipeline manifold fabrication service.

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HOUSTON UNIBOLT TEXAS

Plans For Field Conferences on personnel problems in the drilling industry to be sponsored this fall and winter by AAODC and The University of Texas were developed in a four-day conference in Austin, Texas. Industry and educational institution representatives in attendance were, seated (left to right): Pete Dublin, Donnell Drilling Company, Midland; Mickey Bell, W. H. Black Drilling Company, Midland; Charles Cyrus, University of Texas; M. L. Powers, Oklahoma A. & M. College; A. Q. Sartain, Southern Methodist University; Forrest Smith, Carl B. King Drilling Company, Midland; Luther Bailey, University of Texas. Standing: Jim Conway, University of Texas; Harry Halsell, M. J. Delaney Company, Odessa; R. L. Dailey, John Woodruff, Gordon Oliver, Vernon Bruce and Jack Wiggins, all of the University of Texas petroleum extension training staff; A. L. Franzolino, Southern Methodist University; G. W. Hutcheson, George P. Livermore, Inc., Lubbock; John Carpenter, Kerr-McGee Oil Industries, Inc., Oklahoma City; Jim Brown, Westlund Drilling Company, Midland; Burt Risley, University of Texas; Harry Woodward, Thompson-Carr, Inc., Houston; and W. H. Herndon, Western Company, Midland.

Others present but not in the photograph were George P. Livermore, George P. Livermore, Inc., Lubbock; Claude Pipes, Texas Employers Insurance Association, Dallas; J. Doyle Settle, AAODC, Dallas; and Earl Bowler, The University of Texas.

Joint Exploration Meeting Is Planned for Fort Worth

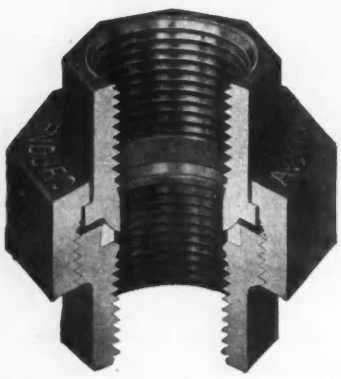
A regional exploration meeting at Fort Worth, scheduled for November 30 and December 1, will be jointly sponsored by the Fort Worth Geophysical Society, the Fort Worth Geological Society, the Dallas Geophysical Society, the Ark-La-Tex Geophysical Society, the Permian Basin Geophysical Society and the Geophysical Society of Tulsa.

The general theme of the meeting will be the exploration problems, both geological and geophysical, of a number of oil provinces of the south-central U. S. New and complementary papers will be presented covering the geology and geophysics of the various provinces. This new departure in subject matter will be augmented by papers of general interest, including several dealing with seismic velocity problems.

A dinner dance is scheduled for Friday evening, December 1, at the Texas Hotel and bus transportation has been arranged for the TCU-SMU football game on Saturday afternoon, December 2.

James L. Morris, president of the Fort Worth Geophysical Society and H. C. Vanderpool, president of Fort Worth Geological Society, are general co-chairmen of the meeting, and George H. Harrington, Jr., is chairman of the Program Committee. They will be assisted by T. R. Shugart, president of the Dallas Geophysical Society, Richard Brewer, president of the Ark-La-Tex Geophysical Society, H. M. Thralls, president of the Geophysical Society of Tulsa and Lorenz Shock, president of the Permian Basin Geophysical Society.

Jefferson Malleable Unions



JEFFERSON'S *ENDURO* unions available in brass-to-iron, and iron-to-iron seats. Certified Air Furnace iron used in the ENDURO line is A.S.T.M.-4733-Grade 35018 malleable, having a 53000# Min. Ten.

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Texas Mid-Continent Group Meets October 3-4 in Dallas

The first major gathering of Texas oil and gas producers since the start of the Korean war is scheduled in Dallas for October 4-5 when the Texas Mid-Continent Oil & Gas Association holds its 31st annual meeting.

Headquarters for the meeting of representatives from all branches of the petroleum industry will be the Adolphus Hotel.

Houston Pipe Line Men Found Club to Discuss Practices

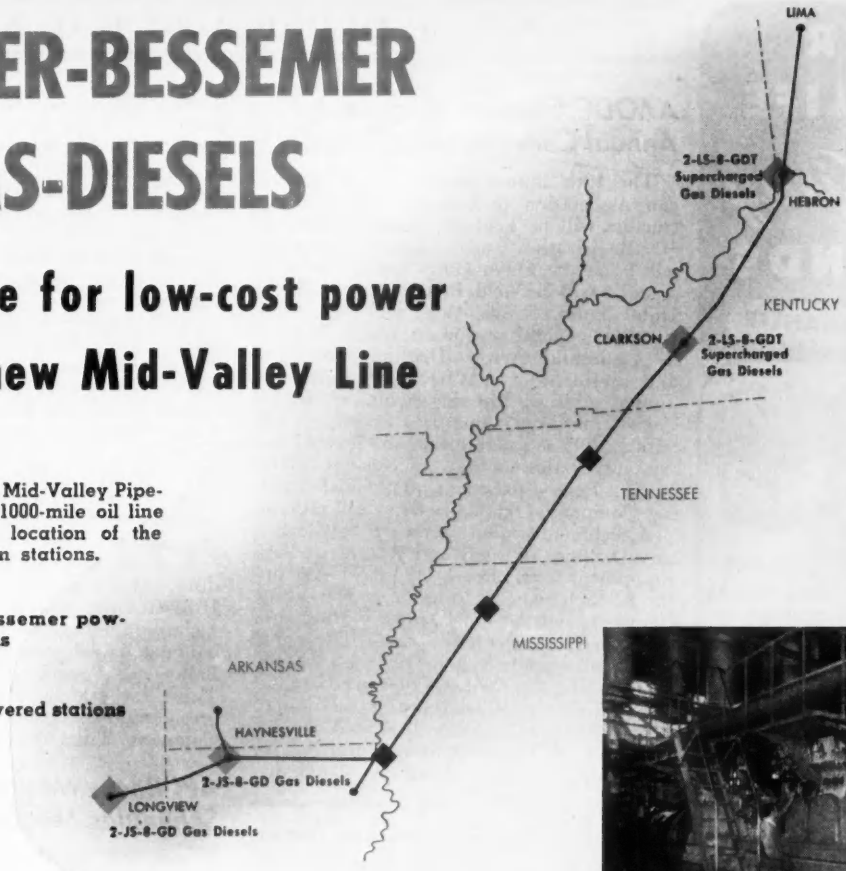
A new organization, the Pipe Liners Club, has been formed in Houston to promote the science of pipe line engineering and the improvement of operating practices. Preliminary organizational meetings have been under the chairmanship of J. E. Green of Shell Pipe Line Company.

Geologists Name Glass

Theo A. Glass, consulting geologist, Mt. Vernon, Ill., has been elected secretary-treasurer of the Illinois Geological Society.

COOPER-BESSEMER GAS-DIESELS

high score for low-cost power on the new Mid-Valley Line

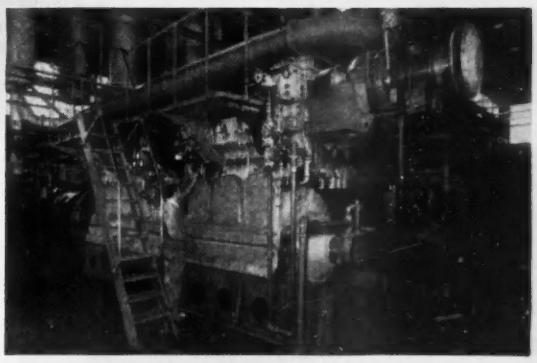


Route map of the Mid-Valley Pipeline Company's 1000-mile oil line system showing location of the line's seven main stations.

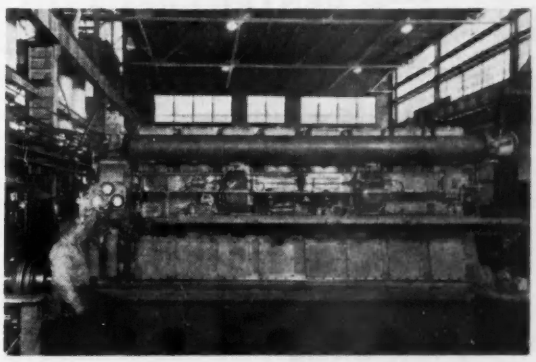
◆ Cooper-Bessemer powered stations

◆ Electric powered stations

Another Example of Efficient Power at Lower Cost



B. F. Relf of Mid-Valley checking a supercharged LS-8 gas-diesel, rated 1715 hp at 327 rpm on the Cooper-Bessemer erection floor. Mid-Valley's Clarkson and Hebron stations in Kentucky will each be powered by two of these modern engines.



C. N. Brindley of Mid-Valley checking a JS-8 gas-diesel, rated 800 hp at 450 rpm on the Cooper-Bessemer erection floor. Units of this type will power Mid-Valley's Longview, Texas, and Haynesville, La., stations—two engines for each station.

WHEN put into operation this Fall, Mid-Valley will be the most modern, most economical of the nation's cross-country oil lines. Highly significant, thorough studies proved that a combination of four gas-diesel powered stations and three electric powered stations assured peak economy. Modern, exceptionally efficient Cooper-Bessemer gas-diesels were picked for the job, will be located as shown on the map.

The smooth operation of Cooper-Bessemer gas-diesels on oil or any combination of gas and oil, means maximum flexibility and uninterrupted service. Even if the gas supply fails completely, these engines will continue to run, fueled by oil bled directly from the line.

If you have power needs coming up, you'll be wise to check into Cooper-Bessemer's latest money-saving engine developments — such as supercharged gas engines and gas-diesels . . . new gains in the power-to-space ratio of oil-burning diesels . . . and supercharged Turboflow compressor engines. Just get in touch with the nearest Cooper-Bessemer office.

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ASSOCIATIONS

AAODC Outlines Program for Annual Convention at Tulsa

The 10th annual meeting of the American Association of Oilwell Drilling Contractors will be held in Tulsa, October 9-10. Registration and committee meetings will be at the Mayo Hotel and the general sessions will be held in the Topaz Room, Hotel Tulsa. R. W. Wire will preside at the first general session at which Warren S. Churchill, Arrow Drilling Company, and president of AAODC, will make the annual address. Monday noon, Frank W. Porter, president, American Petroleum Institute, will be guest speaker at a luncheon and installation of new officers, at which W. T. Payne, president, Big Chief Drilling Company, Oklahoma City, will preside.

A technical session sponsored by the Rotary Drilling Methods and Rotary Drilling Equipment Committees, C. W. Alcorn and B. R. Schabarum, respective committee chairmen, will be held Monday afternoon, October 9, at which the following papers will be presented:

"Care and Maintenance of Slush Pumps," W. J. Redman, Wilson-Snyder division of Oilwell Supply Company, Braddock, Penn.; "Analysis of Surface Casing Failures," B. B. Smith, Loffland Brothers Company, Tulsa; "Effect of Oil Emulsion Mud on Drilling," Orien Van Dyke, Magnet Cove Barium Corporation, and J. P. Weichert, Gulf Oil Corporation, Houston; "Causes and Prevention of Drill Collar Failure," Stanley C. Moore, Drill Collar Service Company, Midland, Texas; "Drill Pipe Fishing With String Shot," Jack Chadderdon, Houston Oilfield Material Company, Houston.

E. C. Brown will preside at the general session Tuesday afternoon at which Joe Zeppa, president, Delta Drilling Company, Tyler, Texas, will present Association resolutions followed by papers: "More Hole for Your Money," C. W. Seibel, regional director, Region VI, U. S. Bureau of Mines; "The Happy Combination," Jules E. Toussaint, general manager, Producing Department, Standard Oil Company of California, San Francisco.

Entertainment features include a buffet dinner at 7 p. m., Monday, at the Southern Hills Country Club, sponsored by the Associate Members of the AAODC, and a banquet Tuesday evening in the Cimarron Ballroom, Fourth and Denver Streets, Tulsa, at which Elmo Thompson, vice president, First National Bank and Trust Company, Tulsa, will be toastmaster.

API Rocky Mountain District Schedules Meeting April 19-20

The 1951 spring meeting of the Rocky Mountain district of the American Petroleum Institute's Division of Production will be held in Casper, Wyo., on April 19 and 20 in the Gladstone Hotel.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, and JULY 2, 1946
Of WORLD OIL, published monthly at Houston, Texas, for October 1, 1950.

State of Texas, County of Harris, ss:

Before me, a Notary Public in and for the State and County aforesaid, personally appeared A. L. Burns, who, having been duly sworn according to law, deposes and says that he is the Business Manager of WORLD OIL and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily, weekly, semiweekly or triweekly newspaper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946, (section 537, Postal Laws and Regulations), printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Ray L. Dudley, 3371 Chevy Chase, Houston, Texas; Editor, Warren L. Baker, 1631 Woodhead, Houston, Texas; Managing Editor, Albert B. Reese, Jr., 4029 Gulf, Houston, Texas; Business Manager, A. L. Burns, No. 7 Chelsea Place, Houston, Texas.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

The Gulf Publishing Company, Houston, Texas; James Anderson, Houston, Texas; A. L. Burns, Houston, Texas; J. F. Carter, Jr., Tulsa, Okla.; Mrs. Mary Margaret Cashman, Houston, Texas; Mrs. Carolyn Dodson Dudley, San Angelo, Texas; June Wooden Dudley Bliss, Trustee for Miss Fredrica Lucinda Dudley, Houston, Texas; Ray L. Dudley, Independent Executor and Trustee of Estate of Dr. N. L. Dudley, Deceased, Houston, Texas; Ray L. Dudley, Houston, Texas; Wm. G. Dudley, Houston, Texas, Mrs. Libbie Rice Farish, Houston, Texas; Wm. V. Gross, Utopia, Texas; Mrs. Anita S. Lane, Houston, Texas; Chas. H. Lane, Houston, Texas; Tom W. Nelson, Houston, Texas; Mrs. Maude G. Sterling, Houston, Texas; O. R. Waller, Chicago, Ill.

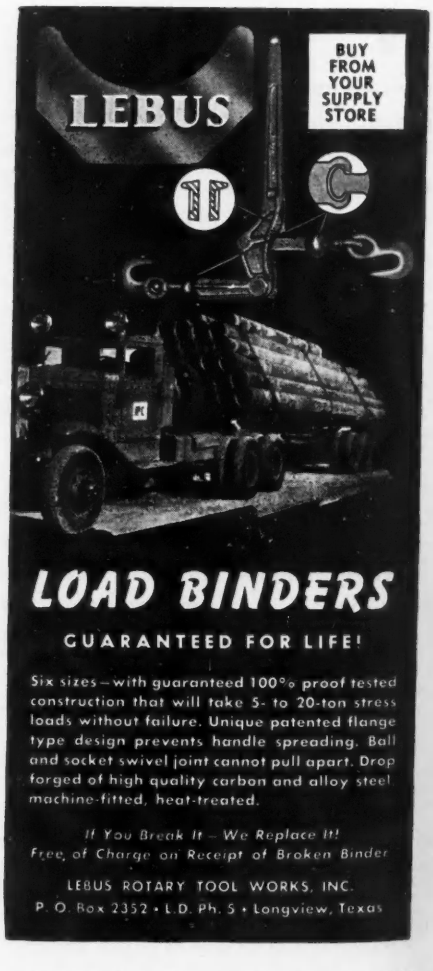
3. That the known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) M. D. Anderson Foundation, Houston, Texas.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. L. BURNS, Business Manager.

Sworn to and subscribed before me this 15th day of August, 1950.

P. J. AUCOIN,
(Seal) Notary Public in and for Harris County, Texas.
(My commission expires June 1, 1951.)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EQUIPMENT AND SERVICE SUPPLIERS' NOTES

Magnaflux Opens New Southwestern Office and Laboratory in Dallas

Magnaflux Corporation has moved into its new office building at 2823 Manor Way, Dallas, George L. C. Dehn, Southwestern manager, announced. The previous office and shop was destroyed by the aircraft crash in Dallas last November.

Included in the new building is an inspection laboratory where local inspection can be done. Several Magnaflux trucks are equipped to handle field inspection work.

Magnaflux Corporation's new office in Dallas.

Homco Moves Supervisory Personnel And Adds Two Branch Service Points

Houston Oil Field Material Company, Inc., has transferred H. H. Hughes from Houma, La., to Lake Charles, La., as district superintendent of that area.

Tom Holland has been transferred from Oklahoma City to New Orleans as general superintendent over Louisiana and Mississippi, with headquarters in Harvey, La.

R. W. Vaughn has moved from Oklahoma City to Midland, Texas, where he serves as assistant general superintendent over the West Texas area. Headquarters are in the Midland Tower, Midland.

C. H. Pollard has been transferred from Oklahoma City to New Iberia, La., as assistant general superintendent over the Directional Drilling department.

Homco also announced the establishment of service points at Lake Charles and Beaumont, Texas.

British Oilfield Equipment Company Will Manufacture Cameron Products

British Oilfield Equipment Company, Ltd., of London and Leeds, Great Britain, announces that it has been granted a manufacturing license by Cameron Ironworks, Inc., Houston, to produce in England a range of Cameron equipment for marketing in the sterling areas. This equipment will include well head assemblies, casing heads and hangers, tubing and tubing packers, chokes and flow wings, blowout preventers, flow line valves, and hydraulic gate valves.

An agreement has also been reached allowing BOFEC to sell in the sterling area the remainder of the Cameron line, manufactured in the U. S.

Cameron equipment will be manufactured by BOFEC in strict accordance with Cameron standards and API specifications under the supervision of Cameron technical supervisors. The Cameron guarantee will cover the complete range of products, whether manufactured in England or America, and complete interchangeability of parts is assured.

Adel Precision Products Changes Corporate Names to Adel Division

Adel Precision Products Company has changed its corporate identity to Adel Division, General Metals Corporation, according to William A. DeRidder, who was named chairman of the board. DeRidder also announced that Fred T. Miller had been named vice president of engineering and sales, and Richard A. Stumm, vice president of manufacturing.

The change became effective upon the consolidation of Adel with two other nationally known manufacturing concerns, Enterprise Engine and Foundry Company of San Francisco, and General Metals Corporation, with California plants at Los Angeles and Oakland and a third at Houston, Texas.

New Company Is Formed by Eastman For Export of Oil Field Equipment

The formation of Eastman International Company, a new organization to handle foreign sales, service, and equipment of the Eastman Oil Well Survey Company, has been announced. The main office is in Denver, with district offices in Long Beach, New York, and Houston. David P. Neill was named general sales manager.

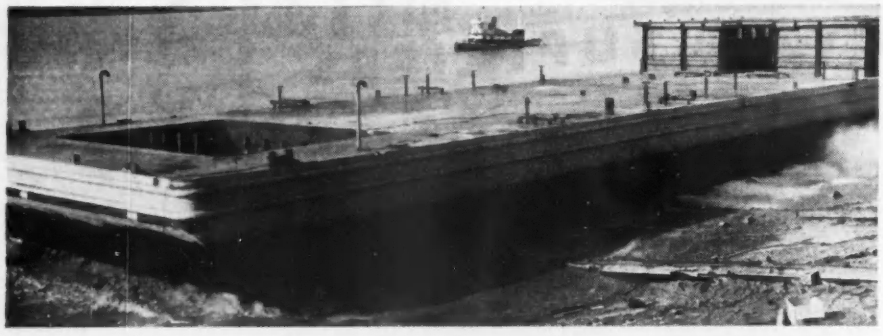
David P. Neill

The board of directors consists of H. John Eastman, president, Hal Benson, vice president, Phyllis M. Freeland, secretary treasurer, and Captain J. E. Treacy, managing director of the Canadian offices. Rudy von Glinski is assistant to the vice president.

SKF Sets Up New Sales Region

SKF Industries, Inc., has established an 11-state sales region, headquartered in San Francisco, which includes territory now serviced by district offices there, in Los Angeles and Portland, and by the Denver branch office. J. C. Bowman, district manager at San Francisco since 1936, has been appointed regional manager.

Roger Henquet, left, executive vice president of Schlumberger Well Surveying Corporation, and R. R. Rieke, sales manager, have just placed Schlumberger's new trademark on a field unit. The trademark will soon be on all Schlumberger trucks and equipment in the field. Log heading designs also have been changed to include the new trademark. Designed by Henquet, it pictures a derrick and the name Schlumberger superimposed on an electrical log.



The giant drilling barge built by Avondale Marine Ways for Rowan Drilling Company is pictured as it slides into the Mississippi River.

Avondale Marine Ways Builds Huge Drilling Rig Barge in Record Time

Exactly one month after the contract was signed and orders to proceed with construction were given, one of the largest drilling rig barges designed for tideland waters was launched at the River Plant of Avondale Marine Ways, Inc., of New Orleans. Built for Rowan Drilling Company, Inc., Fort Worth, the barge is 200 feet long, 54 feet wide and 12 feet deep.

A self contained unit with drilling equipment and power supply on the same barge, Rowan's Drill Rig No. 14 is electrically operated with power furnished by its own generating plant. The drawworks is an Emsco ECA-54, capable of drilling 2½ miles. Mud is supplied by three large pumps. Active mud pits have a capacity of 750 barrels and two reserve mud pits hold 1200 barrels each. The dry mud storage compartment accommodates 7000 sacks.

Lineberry Succeeds A. J. Smith As Black, Sivalls & Bryson Head

The resignation of A. J. Smith as president and director of Black, Sivalls & Bryson, Inc., has been accepted by the board of directors. He is succeeded by Kenneth W. Lineberry, who has been a director of the company since 1946 and has been serving as chief executive officer for the past few weeks.

Lineberry has resigned as vice president and director of F. S. Yantis & Company, Chicago, with which he has been associated for the past 17 years.

Executive and Store Personnel Named by Oil Well Supply Company

Oil Well Supply Company has appointed R. E. Dickson as assistant to the general manager of the Production Planning and Procurement department. Dickson has been district audit supervisor at Dallas for U. S. Steel Corporation of Delaware for the past three years.

In the company's Central Midwest division, Ralph Crowe, manager of the Greggton, Texas, store since March, 1949, has been named manager of the Snyder, Texas, store, succeeding Wayne B. Atkins, who will work on sales promotion in the Snyder area. Crowe is succeeded at Greggton by Gerald Dwight Fisher, former field representative.

D. W. Jacobus, warehouse supervisor at Ponca City, Okla., has been named manager of the branch sales store at Ponca City, in the Mid-Continent division.

Gulf Coast division appointments include that of Chester L. Vines as manager of the Mission, Texas, store. He is succeeded as field representative at Rockport, Texas, by Otto W. Green, former field representative at Pettus, Texas. James W. Andrews is the new district specialty representative for the division's southeast Texas district, with headquarters at Beaumont. Robert E. Beattie, storeman in the Lake Charles, La., store, has been promoted to manager of the Eunice, La., store, succeeding Donald E. Bagby, who has been transferred to field sales with headquarters at Alice, Texas.

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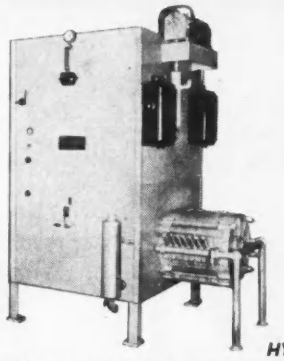
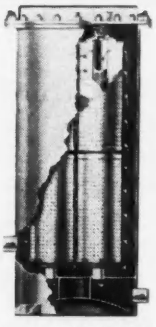
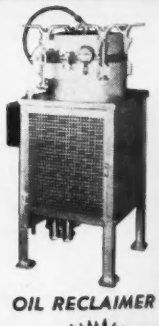


AIRLINE OIL PURIFIER



HYFLOW OIL FILTERS



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A New Plant in Corsicana, Texas, has been acquired by Carter Products Corporation for the production of Carlon plastic pipe. Production will help meet demand in the Southwest for the lightweight, flexible, corrosion-resisting pipe. W. E. Struble, Dallas, and Green Contracting and Engineering Company, Wichita, Kansas, are manufacturer's representatives in the Southwest.

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2. **Outlasta** — for medium speed and average-load conditions.
3. **Durable** — for low speed and light-duty conditions.

New Promotions Are Announced By Axelson Manufacturing Company

J. R. (Jeff) Walker, who has been in charge of the Mid-Continent division of Axelson Manufacturing Company at Tulsa, has been promoted, to general sales manager of the Petroleum Equipment division. He is replaced by K. S. (Ken) Ramey, formerly in charge of the California Sales division. Willard F. (Bill) Goertz will be advanced to the position of California sales manager.

Houston Concern Established to Furnish Pipe for the Oil Industry

W. H. (Buster) Becker has resigned from Syd E. Culbertson Company to open Atlas Pipe, Inc., in Houston. The firm offers a complete pipe service, including sale of new and used pipe, and coating, wrapping, and testing facilities.

Alvin Zwerneman

W. H. Becker

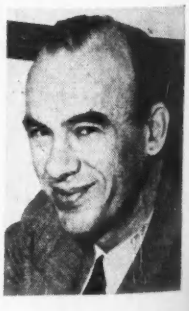
Becker, a graduate lawyer and member of the state and local bar associations, has been closely associated with the oil industry for many years, assisting in the early development of the American Association of Oil Well Drilling Contractors.

Alvin (Dutch) Zwerneman has resigned as vice president and general sales manager of the Axelson Manufacturing Company, Los Angeles, and has acquired a substantial interest in Atlas Pipe, Inc.

In addition to the sale of petroleum pipe, the Atlas organization will also represent the Rasmussen Manufacturing Company, Hollydale, Calif., the E. H. Edwards Company of San Francisco, and Page Oil Tools, Inc., of Long Beach, Calif.

Oil Base Sales Manager Randolph Is Appointed a Vice President

Thad Randolph, sales manager of Oil Base, Inc., has been made a vice president, succeeding J. A. Moore, who has resigned from active participation in the company.



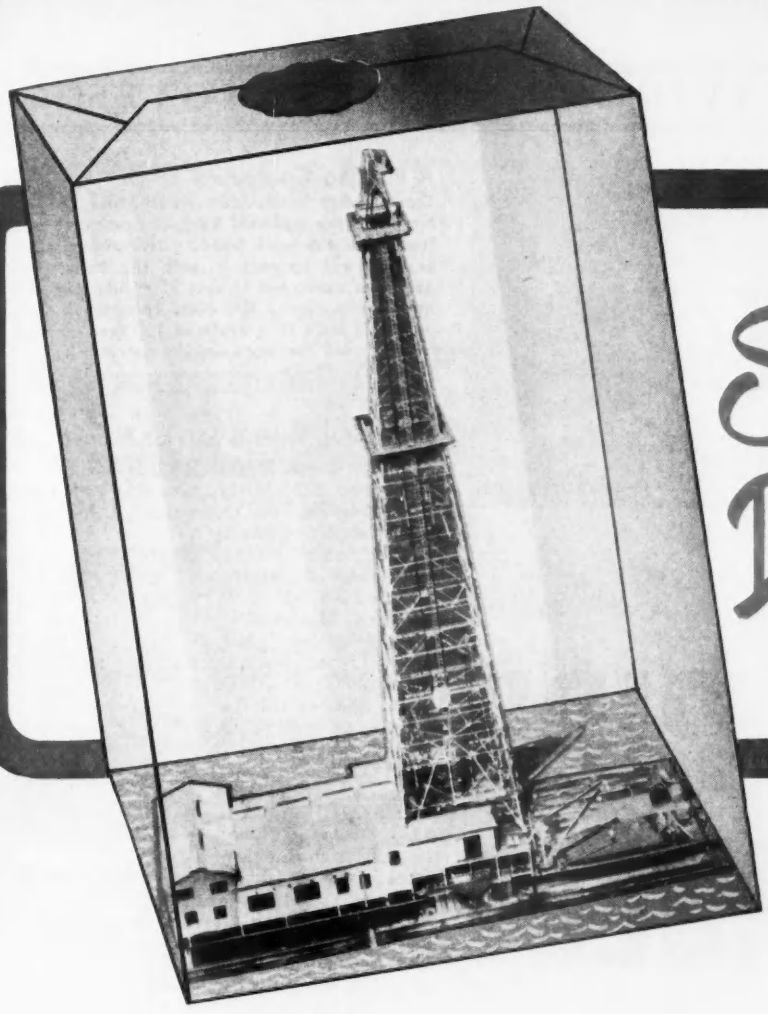
Thad Randolph

Randolph will retain his duties as director of sales for all products manufactured by Oil Base.

Moore continues as a member of the board of directors.

Porter Sells Quimby Pump

Quimby Pump Division of H. K. Porter Company, Inc., has been sold to Warren Steam Pump Company, Inc., T. M. Evans, Porter president, announced.



Submersible Drill Barges-

"A COMPLETE PACKAGE"

BY

Levingston

From crown block to barge bottoms, Levingston is prepared to accept the entire responsibility of constructing and rigging-up your submersible drill barges on a turn-key basis. You select the tools, or equipment, and Levingston's experienced organization will install them for safe and efficient operation on marine locations.

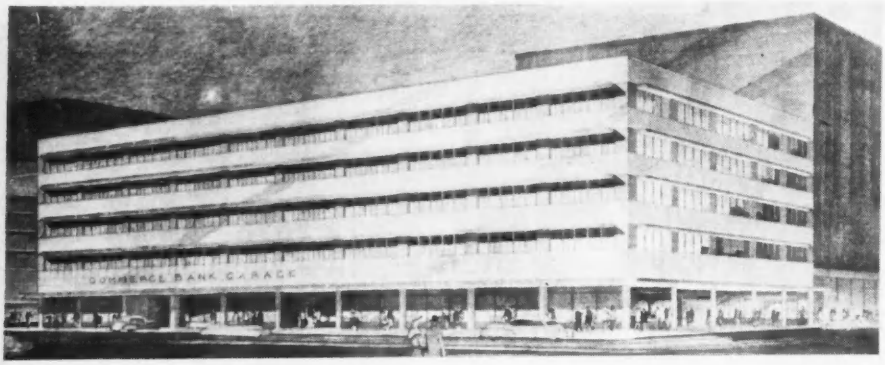
Levingston

SHIPBUILDING COMPANY • ORANGE, TEXAS

SAVE "DOWN TIME" ON MARINE DRILLING EQUIPMENT REPAIRS

Levingston know-how and dry dock facilites provides the industry with a conveniently located repair yard for all types of marine drilling equipment . . . from LST's to drill barges to oil barges.

Day Phone: 8-3521; Night Phones: L. J. Vincent, Repair Superintendent, Phone 8-4516; George Duchamp, Ass't Repair Superintendent, Phone 8-4841.



A Parking Garage will be constructed on Travis Street in Houston for the use of customers of the National Bank of Commerce and tenants of the bank building. An underground passage will connect it with the bank. The garage is estimated to cost $1 million and will have a capacity of 800 cars. The ground floor on Travis back to a depth of 150 feet on Rusk will be occupied by stores.

CARLON

PLASTIC PIPE IS AVAILABLE!

Carlon Plastic Pipe is available in standard line pipe sizes from ½ inch to 8 inches. It is comparable to, and in corrosive conditions it is superior to other types of pipe for lead lines, disposal systems, tank battery hook-ups, gas lines, fresh water lines, salt water disposal tubing and in some cases, production tubing.

Carlon Plastic Pipe Is Used and Has Proven Satisfactory On These Jobs

- GAS LINES
- LEAD LINES
- WATER LINES
- GATHERING LINES
- DISPOSAL TUBING

TELL US YOUR PROBLEM

If you have a problem, either from corrosion or in procuring other types of pipe, tell us about the installation in detail and we will furnish you complete data on Carlon Plastic Pipe, and make recommendations on the type pipe to fill your requirements.

WRITE—WIRE—OR CALL
FOR PRICES AND DELIVERY

GREEN CONTRACTING AND ENGINEERING CO.
103 SOUTH VINE . . . WICHITA, KANSAS
CARTER PRODUCTS CORPORATION, CLEVELAND, OHIO, MFRS.

Harrisburg Sales & Service Names Charles B. Caldwell as President

Charles B. Caldwell, who was associated with Hughes Tool Company for 13 years, has been appointed president of Harrisburg Sales & Service, Inc., 336 M & M Building, Houston.

Charles B. Caldwell

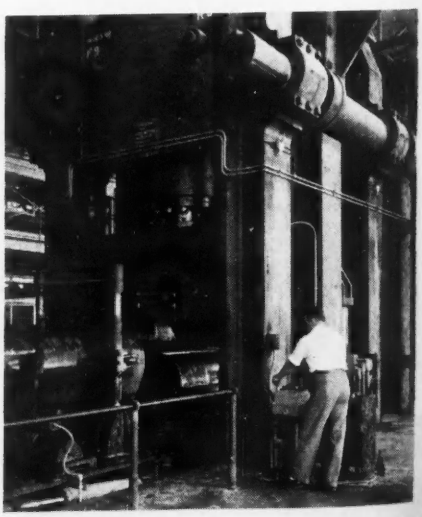
Caldwell was graduated from Amarillo Junior College in 1934, and for the following three years studied mechanical engineering at Rice Institute. He joined Hughes at Houston in 1937, and advanced steadily with that firm until resigning to accept the presidency of Harrisburg.

From 1937 until November of 1947, he was employed as a field salesman. He then was assigned to Oklahoma City as a special sales representative. In December, 1948, he was transferred to Dallas, where he served as a special sales representative.

Production of Big Inch Pipe Starts In A. O. Smith's Houston Plant

Production of large diameter welded steel pipe has begun in Houston at the recently-completed plant of A. O. Smith Corporation of Texas.

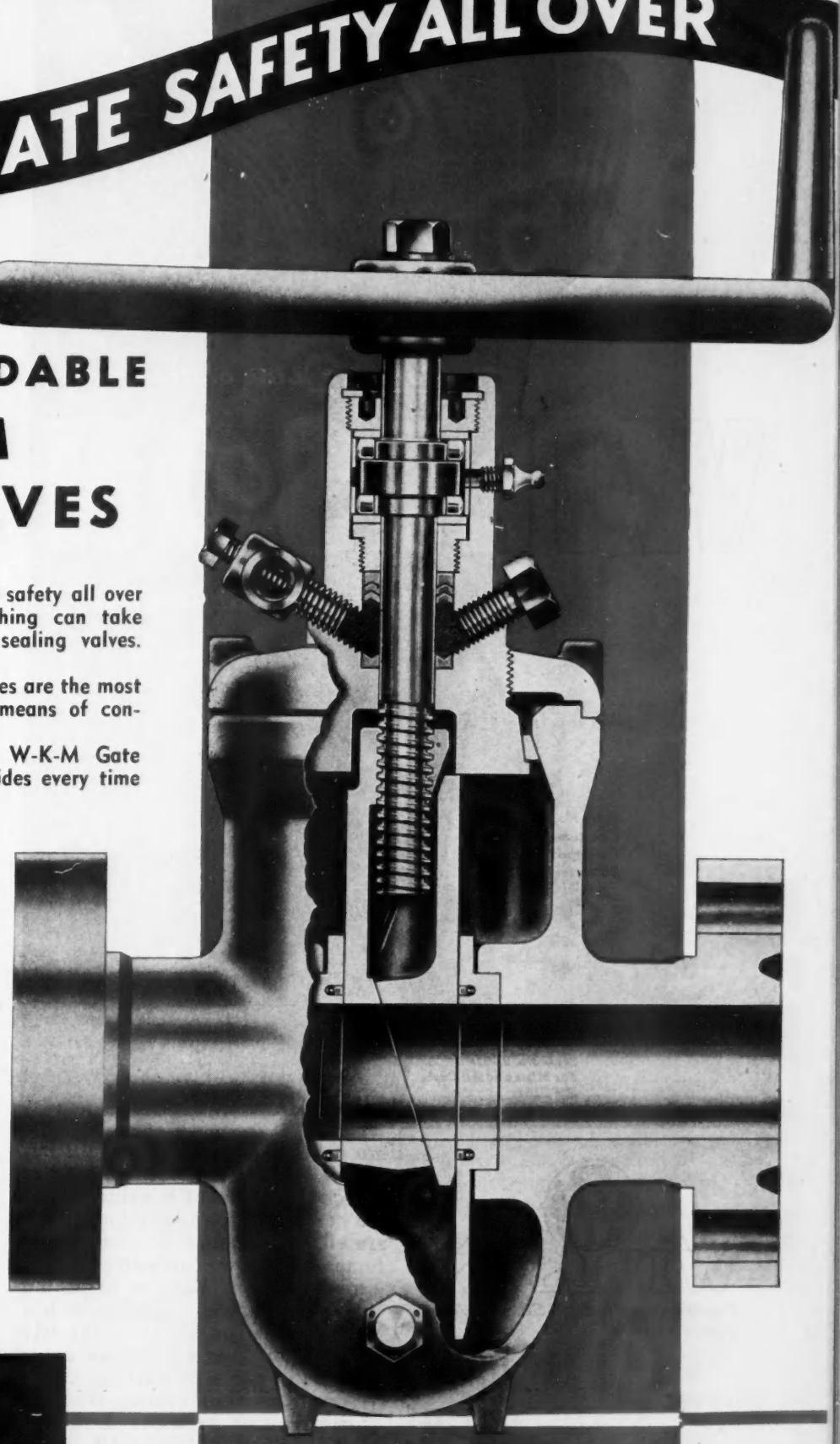
The plant, second largest of its kind in the world, employs more than 400 persons and is scheduled to reach production of approximately 40,000 tons of pipe per month in October.



A gigantic press carries out the next-to-last step in conversion of flat steel into a steel cylinder. The egg-shaped plate moves into the press, where, under tremendous pressure, it becomes a cylinder with a narrow opening.

GIVE YOUR CHRISTMAS TREES MASTER GATE SAFETY ALL OVER

WITH DEPENDABLE W-K-M GATE VALVES



If you suddenly need master gate safety all over your Christmas Tree controls, nothing can take the place of dependable, positive sealing valves. "Gadgets" can't "cut it."

In the long run, W-K-M Gate Valves are the most economical and by far the safest means of controlling high or low pressure wells.

For safety, you can depend on W-K-M Gate Valves to seal completely on both sides every time against full rated pressure. You can be sure that W-K-M Gate Valves will not bind or freeze . . . will open or close easier than any other valve.

For economy, you can depend on W-K-M Gate Valves to give longer life with less maintenance. And after the first life of service, they can be economically renewed for another long period of safe service.

So give your Christmas Trees master-gate safety all over with dependable W-K-M Gate Valves. They are safety insurance . . . additional assurance that your well is always under control. Specify W-K-M Valves. They now control more than 80% of all high pressure wells in the world.

W-K-M Company

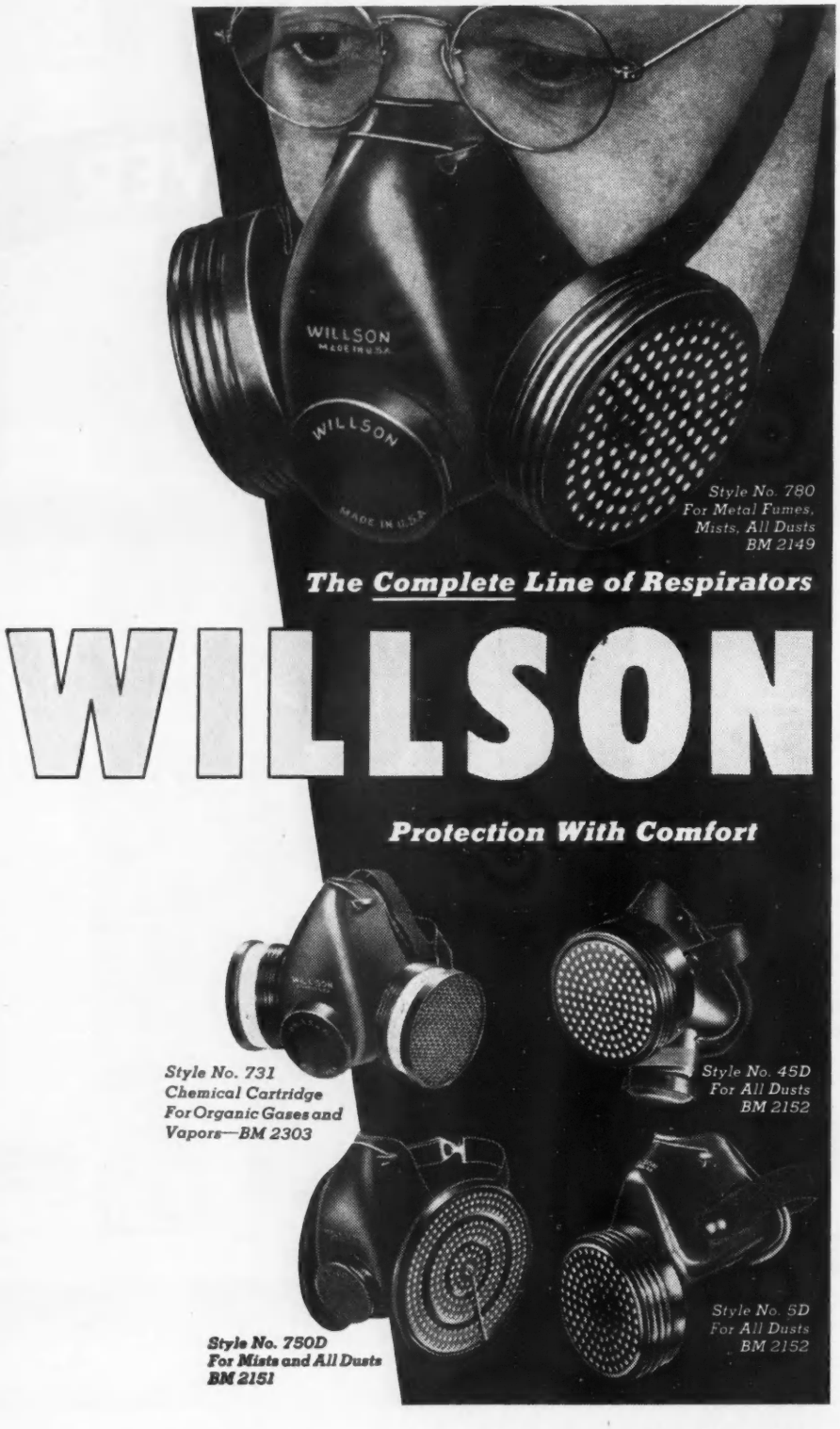
OIL FIELD, PIPE LINE & INDUSTRIAL EQUIPMENT

HOUSTON, TEXAS, U. S. A.

LOS ANGELES

Cable Address: "WILKOMAC"

Export Office: 30 Rockefeller Plaza, New York, N. Y.



WILLSON*
Dependable Products Since 1870
*T.M. Reg. U.S. Pat. Off.

Here is the most complete line of Bureau of Mines approved respiratory protective equipment. It includes filter and cartridge type respirators which are effective against all dusts, mists, fumes and low concentrations of organic vapors. Ease of breathing and comfortable fit assure a low fatigue factor. Choose exactly what you need from selector tables in our new catalog. Get a copy from your nearest WILLSON distributor or write direct to WILLSON PRODUCTS, INC., 104 Thorn St., Reading, Pa.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Fluid Packed Pump Company Makes Many Changes in Its Sales Force

Glen Peters, assistant to the general sales manager of Fluid Packed Pump Company, has been moved from Oklahoma City to Fort Worth. B. G. Wing, formerly of Ardmore, Okla., is now manager of Eastern division at Olney, Ill., and D. A. McDaniels, of Wichita Falls, Texas, is now manager over North Texas, West Texas, New Mexico, and the Panhandle.

District representative Grady Jennings has been transferred from El Dorado, Ark., to Seminole, Okla., and replaced by a new employe, C. C. Hignight. M. W. Curtis has been made assistant division manager of Oklahoma and Kansas, and Harold Palmer has been promoted to assistant division manager over Gulf Coast, East Texas, Louisiana, Mississippi, and Arkansas.

Several changes have been made among field salesmen: Denver Hopkins is at Hebbronville, Texas; Frank Quattrini is at Sundown, Texas; J. A. St. John at Breckenridge, Texas; T. K. Weller has been sent to Russell, Texas; Walter C. Dobbs, Jr., is at Wichita Falls, Texas; M. C. Watkins at Hobbs, N. M., and L. E. Loudermilk at Edmonton, Canada.

Carr Succeeds Lyons at Shreveport As District Manager for Dowell

Orlin W. Lyons, district manager for Dowell Incorporated at Shreveport for the past seven years, has accepted a position on the management staff of Brazos Oil and

Floyd Carr

Orlin W. Lyons

Gas Company, Houston. Floyd Carr, development engineer for Dowell Perfo-Jet Services in the Tulsa general offices, has been appointed district manager at Shreveport.

Lyons has been with Dowell since August, 1936. He was a research engineer in Tulsa until his appointment as Shreveport district manager in 1943.

Carr, a graduate in petroleum engineering from the Colorado School of Mines, joined Dowell in 1939 and has been Perfo-Jet development engineer in Tulsa since February, 1949.

Ryerson Steel Appoints Beckloff As New Tubing Division Manager

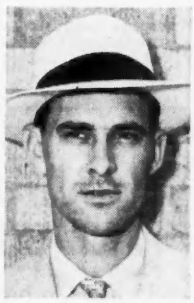
Allen P. Beckloff has been named manager of the Tubular products division of Joseph T. Ryerson & Son, Inc., succeeding R. W. Burt who is now Chicago plant sales manager.

Beckloff started at the Ryerson Cleveland plant in 1941. A year following his return from military service in 1946, he was made manager of the Cleveland tubular products department.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Byron Jackson Company Transfers Heibucher to Mid-Continent Area

C. F. (Bud) Vincent, Mid-Continent sales manager, Byron Jackson Company Oil Tool division, Houston, announced the transfer of Carl R. Heibucher to the BJ Mid-Continent oil tool sales organization.



C. R. Heibucher

Heibucher worked for Baker Oil Tools Company for two years before serving two years in the U. S. Army Air Force, from which he was released in 1946. He has been working in the BJ Oil Tool Engineering Department since 1947.

Bethlehem Supply Company Announces Several Changes in its Personnel

K. C. Winston, former store manager for Bethlehem Supply Company at Wewoka, Okla., has been promoted to special representative, concentrating on pumping unit sales in the central Oklahoma district. He is succeeded at Wewoka by P. W. O'Brien.

H. B. Anderson has been transferred from Great Bend to Wichita, Kansas, and promoted to local representative. He replaces F. W. Jensen, who is now working on pumping unit sales in Kansas.

Arthur Weber, Jr., has been promoted from special representative on machinery sales in the West Texas and New Mexico district to assistant district manager.

Other personnel changes include the promotion to field representative, or the transfer in that capacity, of the following: G. D. Cannaday at Kilgore, Texas; J. T. Allen in the Kilgore Used Material department; H. L. Morton at Shreveport; L. R. Muhlinghause at Corpus Christi; J. L. Callaway at Beaumont; A. M. Rouse at Great Bend, Kansas; W. F. Ware at San Angelo, Texas; J. R. Jones at Hobbs, N. M.; B. M. Queen at Kermit, Texas; R. H. Mathews at Snyder, Texas; J. D. Barker and T. G. Hay at Odessa, Texas.

Seismograph Service Corporation Offers Added Geophysical Services

Seismograph Service Corporation, Tulsa, announced the addition of gravity and magnetometer facilities to the other geophysical exploration services it offers. SSC will thus be able to furnish an integrated service combining the rapid reconnaissance features of the gravity meter and magnetometer with the detailed structural data furnished by the seismograph.

Richard A. Pohly

Richard A. Pohly, formerly manager of Domestic Gravity Surveys, General Geophysical Company, is manager of the new division.

SMALL PIPE
Threaded
IN A JIFFY

Quick, perfect threads on 1/8" to 2" pipe with RIDGID Nos. 00R, 111R, 12R

● You get ready in a hurry with these light, strong ratchet drop-head dies—just snap in the size die head you want and you're all set for threading. Die heads can't fall out—no special dies needed for close-to-wall work. Precision-cut tool steel dies for smooth perfect threads. Ask your Supply House for work-saver RIDGIDS No. 00R, 1/8" to 1"; No. 111R, 1/8" to 1¼"; No. 12R, 1/8" to 2."

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL CO. • ELYRIA, OHIO

WORLD OIL'S Trading Post

CLASSIFIED ADS

SERVICES · PERSONNEL · USED EQUIPMENT

RATES: Regular Classified (undisplayed) set in this size type: 10 cents per word. If Box Number is to be used count an additional six words. Replies forwarded without charge. Situation Wanted: 5 cents per word. Display advertisements, set in suitably larger type with ruled border: $9.00 per column inch per insertion. Situation Wanted: $4.50 per column inch. **All classified ads payable in advance.** 10% Discount if 3 or more insertions are ordered at one time. **COPY DEADLINE:** 5th of month preceding date of issue. Send copy and checks to: Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.

FOR SALE

FOR SALE
at Eunice, New Mexico

1—10,000′ Power Rig complete less drill stem and drill collars —Wilson Titan Draw Works—3 L.R.O. Waukeshas—A-1 condition.

Approximately 5 acre yard and camp all enclosed by fence. Shop building 60′ x 30.′ Fine for drilling or hauling contractor. All utilities in.

Extra drilling equipment such as swivels, hooks, elevators, links, blow out preventors, mud pumps, engines, etc.

Contact

ASHBY DRILLING COMPANY

Phone: Logan 6-6639 — 3415 Westminster Avenue

DALLAS, TEXAS

FOR SALE

■ Well drills, spudders, rotaries, core-drills. All sizes new and used equipment. Tools, drill pipe, cable, pipe. Fishing tools rented. Everything for well drilling. Pressey & Son, Pueblo, Colorado.

■ Completely rebuilt and guaranteed for 60 days, Climax Model R41 gasoline power unit with clutch. 89 net horsepower at 1200 RPM, 72 at 900 RPM continuous. Used less than a year. $1500.00. Wm. F. Surgi Equipment Corporation, P. O. Box 1309, New Orleans, Louisiana.

■ Odessa, Texas. 30 acres suitable for spur track — Close in — Ideal for any commercial enterprise. Price $30,000. Ray Britton Agency —302 West 5th St. Ph. 2411.

■ FOR SALE: New 100 ton hydraulic, pipe, tube and shape bending press, $5000 f.o.b., Astoria, Oregon. Orval Eaton, City Hall, Astoria, Oregon.

■ Two used ten-thousand barrel welded tanks, knocked down, match marked, ⅜″ bottoms. Bayou Welding Works. Box 78, New Iberia, Louisiana.

HELP WANTED

PETROLEUM TECHNOLOGIST

Skilled particularly in reservoir engineering, production, and drilling. Must be recognized authority in the field with outstanding record of accomplishment and acquaintance in the industry. To assume responsibility for and be Director of our Petroleum Technology Division. **Southwest Research Institute,** San Antonio, Texas.

HELP WANTED

Diamond driller with experience in oil well diamond core work, for sales and service position with reputable oil field service company. Man with sales experience preferred. Give full particulars and salary expected. Write Box 96-W, c/o WORLD OIL, Houston, Texas.

DRILLING SUPERINTENDENT

Mid-Continent drilling concern will have opening August 15th for Assistant Drilling Superintendent; age 30 to 35, who has been in supervisory capacity for at least five years as Drilling Superintendent or Tool Pusher. Must have good personality; initiative; and fair educational background. In replying give past five year employment record; state age, marital status and salary expected. All replies handled strictly confidential. Box 89-W, World Oil, Houston, Texas.

EMPLOYMENT SERVICES

■ EXECUTIVE-CONTEMPLATING a change? Your personal requirements met thru our flexible procedures, affording full protection of your present position. We have the know-how and the nationwide contacts to negotiate successfully for you. Details on request, mailed under confidential cover. Jepson Executive Service (Est. 1939), 1050 Porter Bldg., Kansas City 2, Mo.

SITUATION WANTED

■ Geologist. Twenty years experience. Subsurface, land, titles, exploration. Desires connection. Small company or active Independent. Texas, Gulf Coast or Foreign. Box 93-W, c/o WORLD OIL, Houston, Texas.

Drilling contractor operating in West Texas and New Mexico desires to contact small or medium-sized independent oil company who needs an operating manager. Personal interview desired. Twenty years experience in all phases of the oil industry. Address replies to Box 94-W, WORLD OIL, Houston 1, Texas.

LAND AND EXPLORATION

Office Supervisor, Attorney, draft exempt, now employed with major oil company desires change. Will relocate.

Box 95-W, c/o WORLD OIL, Houston, Texas

FOR RENT

FOR RENT

1—1055-LC, P&H dragline or crane, 100′ boom, 4 c.y. bucket.
1—955-LC, P&H dragline or crane, 90′ boom, 3 c.y. bucket.

Usona Construction Co.
925 Boatmens Bank Bldg.
Tel. Co. 3314 — St. Louis 2, Mo.

SERVICES

ELECTRICAL LOG ANALYSIS

Electrical well logs (Schlumberger, Halliburton, etc.) interpreted at rate of 1 cent per drilled foot. Minimum charge $25.00. Send check and 2 copies of log (we keep 1). Electrical Log Analysis Co., West Bldg., Houston, Texas.

WANTED TO BUY

■ We WILL BUY Producing Oil Royalties. Send Particulars. Standard Security Co., 115 Broadway, New York 6, New York.

FOR LEASE OR SALE

BUSINESS PROPERTY

Owner has available for lease or sale property just outside Houston city limits ideally located and suited for oil equipment supply company, drilling contractor or geophysical company. 400 ft. frontage, 550 ft. deep near junction Almeda-Genoa and Chocolate Bayou paved highways. 800 sq. ft. building, hot and cold running water, on 2500 sq. ft. concrete slab completely roofed. Natural gas, sewerage, 220 volt power, deep water well with pump. Property all graded with Cyclone fence across front. One acre shelled car parking lot. Contact owner E. K. Nold, 2521 Reba Drive, Houston, Telephone LInden 3997.

Use the Trading Post For Sale, Services

New Books, Maps and Movies

Conservation

"Oil and Gas Conservation, Development and Production," a new book by Park J. Jones, Houston consultant, is a non-technical discussion of the economic and physical factors which enter into the development and production of oil leases.

The book deals largely with optimum producing methods, and points out how conservation laws can be applied on different types of reservoirs to, (a) maximize ultimate oil recovery, (b) minimize drilling of unnecessary wells on small tracts and certain edge leases, (c) minimize unnecessary production of gas and/or water, and (d) at the same time enable landowners and operators to protect themselves against loss of oil by migration.

A new conservation plan is proposed wherein each group of two or more leases becomes a single lease on paper for operating purposes. This would permit the location and production of wells to better advantage, while minimizing drilling and unnecessary production of gas and water so as to maximize ultimate recovery and reduce development costs.

To provide a full understanding of optimum producing methods the following chapters have been included: Characteristics of Reservoirs; Properties of Reservoir Gas; Properties of Reservoir Liquids; Economics of Producing Reservoirs; Pressure Maintenance with Water; Pressure Maintenance with Gas; Declining Pressure in Oil Reservoirs; Water Encroachment into Oil Reservoirs; Economics of Flooding; Natural Gas Reservoirs and Wells; Condensate Production by Cycling; Condensate and Sales Gas Production by Injecting Water; Oil Conservation; and Gas Conservation.

The Gulf Publishing Company, Box 2608, Houston 1, $6.

Midwest Map

A four-section map of the "Midwest Oil Basin" shows oil pools, gas wells, dry holes, U.S.G.S. bench marks and highways. Reproduced in two colors, the map is drawn to a scale of ½ inch equals 1 mile. Included with the maps is a chart of the subsurface strata of the Midwest Oil Basin.

Jerry Robertson's Tri-State Oil Reports, Court Building, Evansville 8, Ind., each section $5.

Plant Engineering

"Plant Engineering Handbook" is a 1955-page compendium of industrial know-how which has previously appeared only in specialized reference works. This handbook tells how to manage, operate and maintain industrial plants, and presents the essentials of good plant engineering practices in 77 major areas of plant operation and maintenance.

William Staniar, editor-in-chief, and the 86 contributing authors worked for 5 years to compile information on efficient and economical operations and production in industrial manufacturing plants.

The book deals with industry's consumption and conservation of basic resources, with management engineering, with industrial construction, fire protection, maintenance, with industrial power and its uses, with air handling, materials handling, and the handling of services. Specialized subjects of instrumentation, bearings and lubrication, engineering materials and mechanical power also are presented.

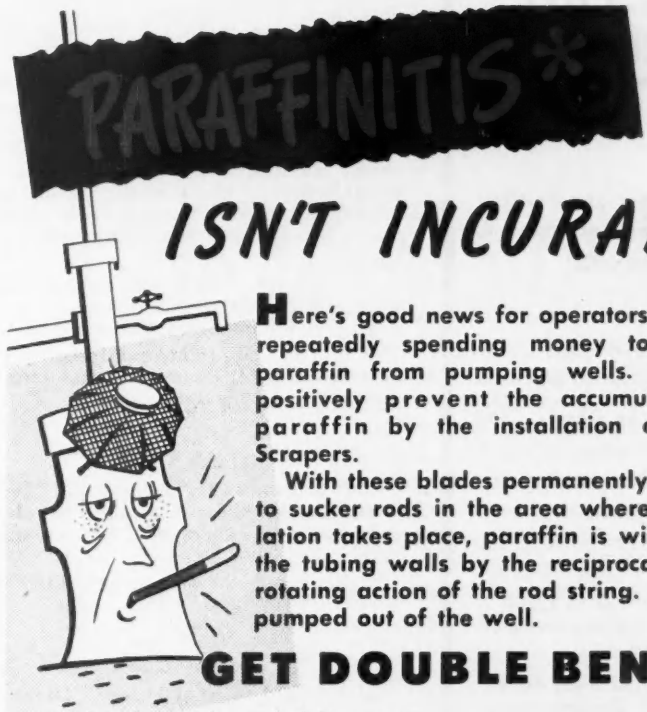
McGraw-Hill Book Company, 327 West 42nd Street, New York City, $15.

Illinois Secondary Recovery

Secondary recovery methods used in the older fields of Illinois, including vacuum, gas, air repressuring and water flooding, are discussed in a new paper, "Secondary Recovery in Illinois," by Frederick Squires, Paul G. Luckhardt, and Alfred H. Bell of the Illinois State Geological Survey.

The paper consists primarily of a statistical report of results obtained by repressuring and water flooding in Illinois to January 1, 1947.

State Geological Survey Division, 100 Natural Resources Building, University of Illinois Campus, Urbana, Ill.



ISN'T INCURABLE

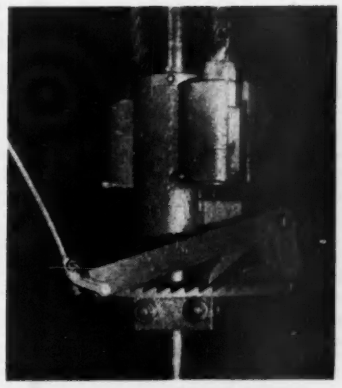
Here's good news for operators who are repeatedly spending money to remove paraffin from pumping wells. You can positively prevent the accumulation of paraffin by the installation of Huber Scrapers.

With these blades permanently attached to sucker rods in the area where accumulation takes place, paraffin is wiped from the tubing walls by the reciprocating and rotating action of the rod string. It is then pumped out of the well.

GET DOUBLE BENEFIT

Only with the Huber method do you get the double benefit of the combined rotating and reciprocating motion which wipes paraffin from the tubing in particles so small they go out in solution . . . so small they can not clog tubing, scrapers, or flow lines. Rod rotation prolongs coupling life by equally distributing wear . . . prolongs pump life and efficiency by equalizing wear on working barrel. Get this added benefit while eliminating paraffin accumulation by installing Huber Scrapers and Huber Rotating Rod Hangers.

Install Huber Paraffin Scrapers and Rotating Rod Hanger, NOW! End costly, frequent steaming out or rod pulling to remove paraffin.



*Congestion caused by the accumulation of paraffin in pumping wells.

For further information see your local supply store, or write

J. M. HUBER CORPORATION,

Box 831 . . . . . Borger, Texas

HUBER

PARAFFIN SCRAPERS

SCRAPE AS THEY ROTATE AS THEY RECIPROCATE

DRILLING EQUIPMENT MFG. CO.
DEMCO
OKLAHOMA CITY, OKLA. U.S.A.

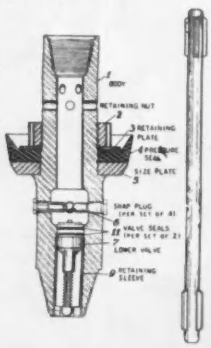
COMBINATION
CASING AND BLOW-OUT PREVENTER, TESTER

Are you insured against disastrous blowouts?

Don't guess . . . Be Sure! Be Safe! Get the Demco Combination Casing & Blowout Preventer Tester.

- Blowout Preventer can be tested at any Pressure without excessive pressure against pump.
- Casing can be tested at any depth—without applying pressure against formation; without pulling vacuum or swabbing hole when coming out after test has been made.

Part Nos. 3, 4 & 5 are removable and may be replaced with corresponding parts of different size for various size casing.



Always specify Demco Products for Safety, Service & Economy.

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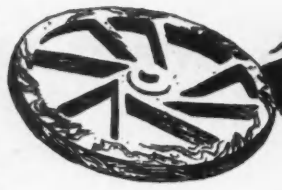
DRILLING EQUIPMENT MFG. CO.
OKLAHOMA CITY, OKLAHOMA
PHONE 6-1342 845 S.E. 29th St. Box 4272



SQUEAKS from the BULLWHEEL

A Bang-Up Time

"I hear you had some fireworks at your home last night."

"Yes, someone told father the new maid was dynamite and he decided to investigate."

"What happened?"

"Well, the moment he touched her she exploded; mother went through the roof, grandma hit the ceiling and poor old dad went all to pieces!"

Know Thyself

A visiting minister denounced horse racing in a town famous for the sport. One of the principal patrons of the track, a wealthy citizen with sporting proclivities, always attended that church. The minister was informed of this after the sermon and determined to make amends to the sportsman who was a generous contributor to the church.

"I'm afraid I touched one of your weaknesses," said the clergyman, "but it was quite unintentional, I assure you."

"Oh, that's all right," said the sportsman genially. "It's a mighty poor sermon that doesn't hit me somewhere."

DeLuxe Model

The ardent swain whispered, "Those lovely hands, those luscious lips, those gorgeous eyes—where did you get those eyes?"

Unimpressed, the lady answered: "They came with my head."

Double Take

Men looked twice at Deborah Drew;
She has hidden charms but many a clue.

Lump Sum

"Say, mister," said the tramp, "can you spare me two dollars for a cup of coffee?"

"Two dollars? A cup of coffee doesn't cost two dollars."

"Yeah, but I'm putting all my begs in one ask-it."

"Why, Mr. Hadley! An oil well of my very own! Whatever for?"

What the Doctor Ordered

Attendant (in filling station): "Boss, your doctor's in here with a flat tire."

Boss: "Swell! Diagnose the trouble as a puncture wound resulting in prolapsis of the perimeter. Prescribe plastic surgery followed by the administration of violent flatulents, and charge him accordingly. That's what he's been doing to me."

Perishable Goods

"Why are you rushing about so on such a hot day?"

"I'm trying to get something for my husband."

"Had any offers?"

See No Evil

One of the staff stopped at a small hot dog stand the other day and ordered coffee. Just to make conversation, he remarked idly to the proprietor: "It looks like rain, doesn't it?

"Well," snapped the testy proprietor, "it tastes like coffee, anyway."

in **DALLAS**

Best by Guest Test

LOMA ALTO HOTEL
4518 Lemmon Ave.
Wm. G. Martin Mgr.

LAWN HOTEL
3718 Lemmon Ave.
John W. McCann, Mgr.

LAKEWOOD HOTEL
1818 Abrams Rd.
Paul C. Bryant, Mgr.

and now—the new LYNN HOTEL
101 Air Conditioned Rooms . . 3405 Gaston Avenue . . Charles A. Closson, Mgr.

McCullough Services

A ELECTRIC WIRE LINE SERVICES

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2. BRIDGING PLUGS—Drillable, expandable. McCullough and Baker.
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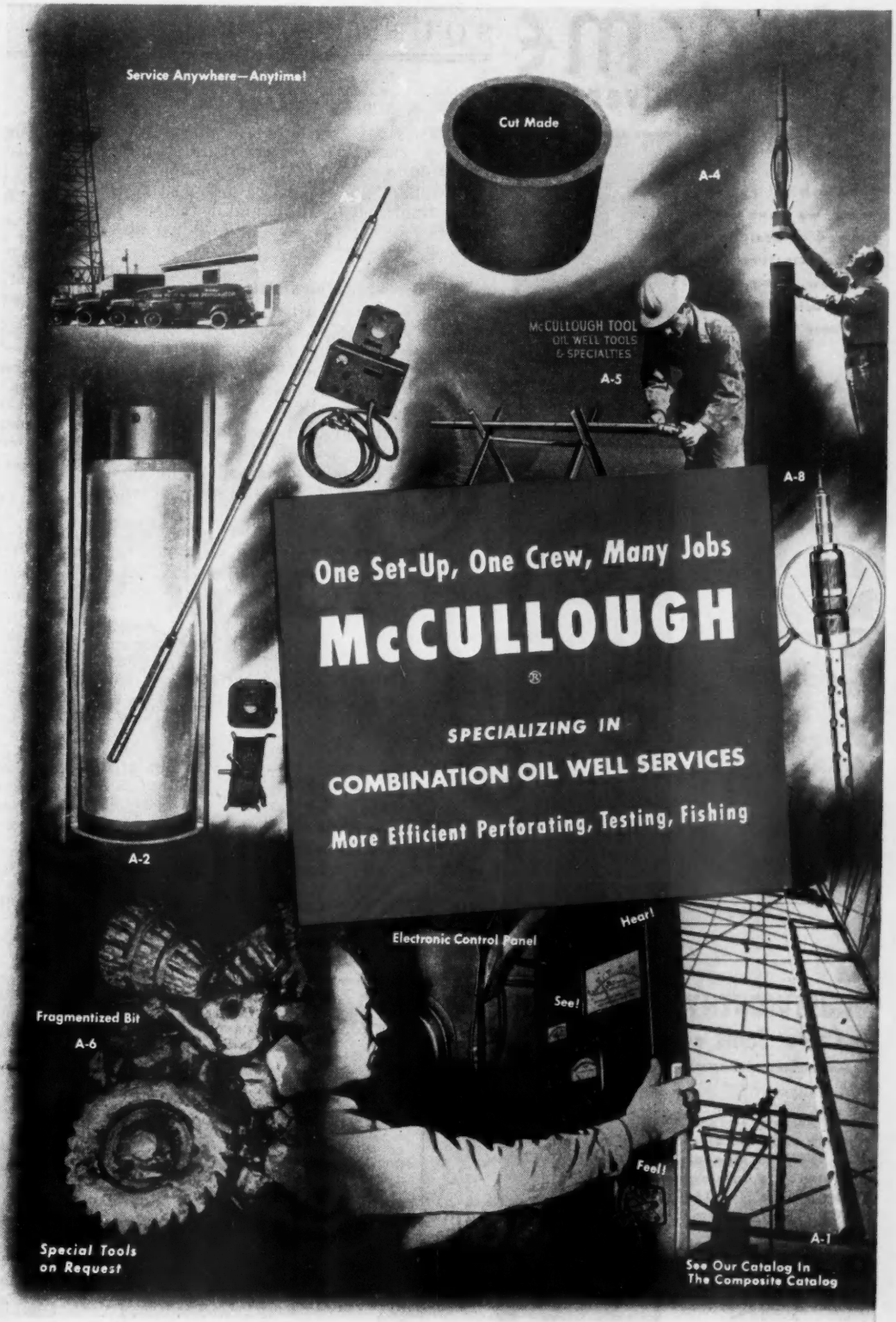
7. ROTARY RELEASING SPEARS—Engages or disengages at will.
8. GUN TESTER—Water shut-off, perforating, testing in one run.

*Exclusive McCullough Services



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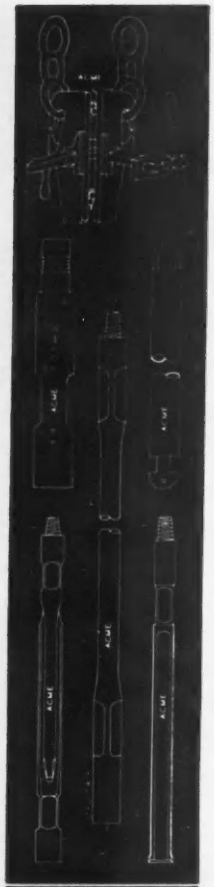

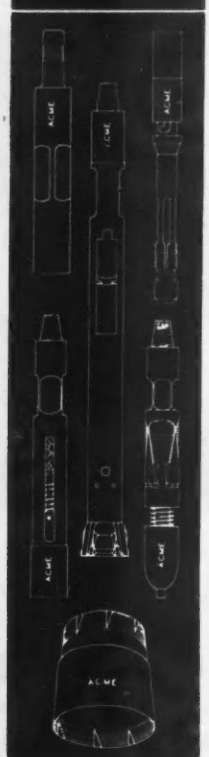

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SQUEAKS FROM THE BULLWHEEL

Time Will Tell

"Why did you tell my mother what time I came home last night?" the grown-up son asked the new maid.

"I didn't," she replied. "She asked me what time you came in and I told her I was too busy cooking breakfast to look at the clock."

The Whistle Blows

Trying to rest after an exceedingly hard day at the office, poor father was being bedeviled by a stream of unanswerable question from little Willie

"What do you do down at the office?" the youngster finally asked.

"Nothing!" shouted the father in exasperation.

After a thoughtful pause, Willie inquired, "Pop, how do you know when you're through?"

You Can Always Tell a Lady

"Say, what's that crawling on the wall?"

"Lady bug."

"Gad! What eyesight!"

Culverts and Culbertson

"Is this the Hercules Bridge Company?"

"Yes."

"What do you do when you get all spades?"

Slide of Hand

The oldtimer watched the trombonist play for quite a long time . . . and said finally: "There's a trick to it—that feller ain't really swallering it."

No Tools

"Is your husband a book-worm?"

"No; no book."

Room for Improvement

Doctor (after examining patient): "I don't like the looks of your husband, Mrs. Millmoss."

Mrs. Millmoss: "I don't either, doctor, but he's so kind to the children."

The Gracious Phrase

A fellow once said it is a good idea, when you hand out flattery, to lay it on thick—it won't gag anybody. This is probably explained by the fact that fools swallow flattery at one mouthful and drink truth drop by drop.

Tragedy in One Act

Scene: A lonely road, with youth and lovely young maid in car.

Car falters, then stops.

Calloused Youth: Outto gas, by gad!

Poor-but-Honest-Girl: Oh, yeah! (Produces flask concealed in stocking.)

Cal. Y. (in highly receptive mood): A-a-h-h! What's in that flask?

P-b-H Girl: Gasoline.

Step Down

A visitor at a golf club paid his green fees and fixed up a match. At the first tee he made a wild swing and completely missed the ball.

"By George!" he exclaimed. "It's a good thing I found out right at the start. This course is at least two inches lower than the one I usually play on!"

* LANE-WELLS SHAPED-CHARGE PERFORATING-THAT IS!

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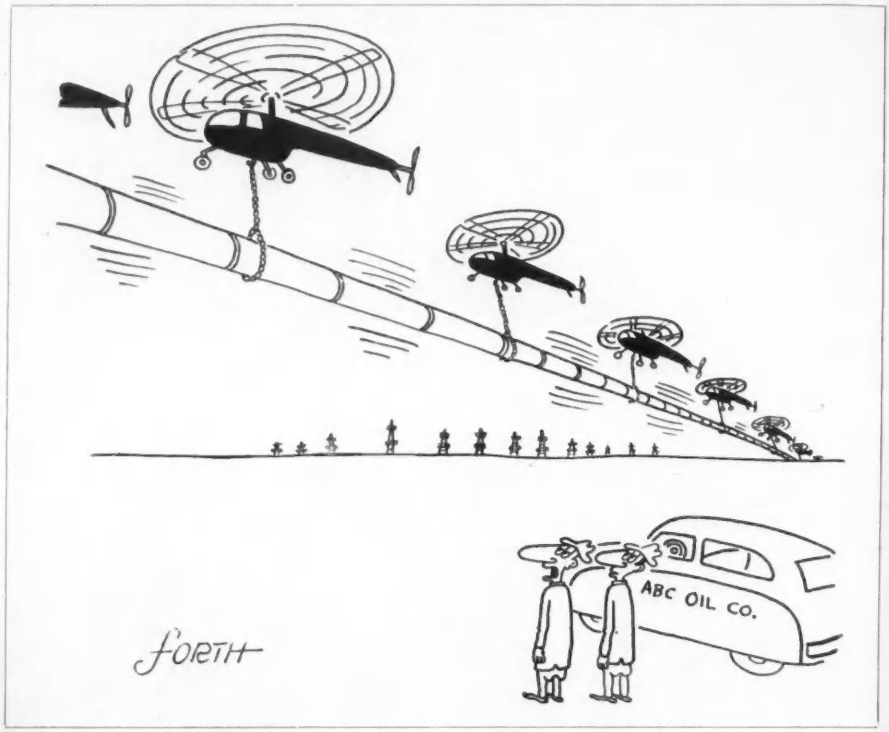
SQUEAKS FROM THE BULLWHEEL



"Just think, Rogers—I finally solved the corrosion problem!"

You're Another!

One angry skunk to another:
"So do you!"

Beulah Land

Having taken a few too many drinks at a hotel dance, a pretty young thing ran out of doors, fainted, and fell over a trash barrel. A young man saw her, picked her up and carried her to his room. The next morning he wired his partner out of the state: "CLOSE OFFICE, SELL EVERYTHING. COME TO TEXAS. THEY THROW AWAY BETTER STUFF HERE IN TEXAS THAN YOU CAN BUY IN OTHER STATES."

System

"Joe, how do you expect to accomplish anything with three good-looking stenographers in your office?" we asked.

"By giving two of them a day off," was the quick reply.

The Inside Story

It was Zeb's first trip to the city, and after registering at the hotel across the street from the train station, he set out to see the sights. In the course of his meandering, he passed a pawn shop's display windows and there espied an assortment of pocket watches. Fascinated, he went inside and inquired of the clerk, "Whut's them round things what's got a little stick that goes swishin' around?"

Informed that they were watches, Zeb then wanted to know what they were for.

"They tell you the time," the clerk explained. "Here, just hold it up to your ear and listen, it will tell you the time."

Zeb held the watch to his ear and heard the tic-tic-tic-tic. "Why it sure does" he exclaimed. Completely charmed, he paid the dollar purchase price and left the shop, owner of a pocket watch.

Frequently, as he continued his exploring, he would pause, pull out the watch, and ask "Whut time is it?" Then he would hold the watch to his ear, and listen to the reassuring tic-tic-tic-tic. "That's whut I thought," he'd say, entranced by the consistency and accuracy of the watch.

Weary, he returned to his hotel room and retired. First thing on awakening the next morning, Zeb rushed to the dresser and picked up the watch. "Whut time is it?" he asked eagerly. This time there came no tic-tic-tic-tic. Alarmed, Zeb screamed again, "WHUT TIME IS IT?" But still no sound from the run-down watch.

Furious, Zeb threw the watch to the floor, and with the heel of his heavy boot stamped it. The face of the watch shattered, cogs flew out, springs unwound, pins crumbled, wheels rolled around the room. Aghast, Zeb surveyed the ruins, and trembling, he blurted out an apology, "Ah'm sorry. Ah never would of done it if Ah'd knowed you was going to be a mother!"

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